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INTRODUCTION

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **968**

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Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **1001**

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R. E. Rolling, D. O. Murray, and K. N. Marshall Dec. 1969
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An analytical and experimental study was made of the possible limitations existent in utilizing small-scale models for determination of spacecraft thermal behavior. A potential limitation in scale factor, experimental accuracy, and accuracy in model design is associated with each spacecraft design. Individual problem areas of thermal modeling are treated separately. Author
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VOLUME 9 NUMBER 7 / APRIL 8, 1971

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N71-16901# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYTICAL SOLUTIONS FOR THE CASE OF FLYING VEHICLE MOTION AT LOW ANGLES OF ATTACK. CHAPTER 8. THREE DIMENSIONAL MOTION
G. E. Kuzmak [1970] 10 p refs Transl. into ENGLISH from the book "Dinamika Neupravliaemogo Dvizheniia Letatelnykh Apparatov pri Ukhode v Atmosferu" Moscow, Nauka Press, 1970 p 307–321
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The three-dimensional motion of a flying vehicle at low angles of attack is examined. Emphasis is given to the EE' section of the trajectory, which abuts directly on the boundary of the atmosphere. A linear theory of three-dimensional motion is discussed. Author

N71-16902# Lockheed Missiles and Space Co., Palo Alto, Calif.
VISCOUS GAS FLOW IN A SHOCK LAYER IN THE PRESENCE OF EQUILIBRIUM CHEMICAL REACTIONS
I. M. Breev [1970] 4 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 4, 1970 p 150–153
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Stationary supersonic air flow around a sphere is considered taking into account viscosity, heat conduction, and real physiochemical processes. Under the assumption of local thermodynamic equilibrium, the flow in the shock layer is investigated at flight velocities of 3 to 10 km/s. Simplified Navier-Stokes equations, whose solution is found by finite differences, are used to describe the flow. The case of a cooled body surface is examined. A distribution of the gasdynamic parameters is obtained in different flow modes. The heat flux and friction coefficient distribution as a function of the free stream parameters and the sphere radius is investigated. The shape and location of the shock wave are determined, and streamlines and sonic lines are constructed. Author

N71-16903# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF THE VALUE OF ENTROPY ON THE SURFACE OF A BODY OF REVOLUTION AT A NONZERO ANGLE OF ATTACK
M. D. Ladyzhenskii [1970] 2 p Transl. into ENGLISH from the book "Prostranstvennye Giperzvukovye Techeniia Gaza" Moscow, Mashinostroenie, 1968 p 28–29
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The entropy takes on its maximum value on the surface of a body of revolution at a zero angle of attack. Computations and experiments show that the entropy retains its maximum value even at nonzero angles of attack, to the accuracy obtained in these computations and experiments. Author

N71-17088# National Physical Lab., Teddington (England). Aerodynamics Div.
AN EXPERIMENTAL INVESTIGATION OF WIND-TUNNEL WALL CONDITIONS FOR INTERFERENCE-FREE DYNAMIC MEASUREMENTS
A. W. Moore and K. C. Wight Dec. 1969 50 p refs
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Results of dynamic tests on two model half-wings performing pitching oscillations in a tunnel with a slotted roof and floor and perforations of variable size behind the slots are presented. A porosity which gives small interference for all speeds in the range from 0.40 to 1.05 M is discussed and a method is suggested for selecting a wall porosity to give interference-free damping derivatives; interference-free stiffness derivatives are not simultaneously obtained and small corrections to measured values are required. Author (ESRO)

N71-17089# National Physical Lab., Teddington (England). Aerodynamics Div.
SOME OBSERVATIONS ON VORTEX SHEDDING AND ACOUSTIC RESONANCES
M. Gaster Jan. 1970 17 p refs
(NPL-AERO-1311; ARC-31829) Copyright. Avail: NTIS

Acoustic resonances excited by vortex shedding from cylinders and plates are discussed. It is shown that very powerful resonances can be produced, but that these are determined by the dimensions of the wind tunnel and not solely by the model as previously proposed. Author (ESRO)

N71-17103# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
RECTANGULAR AND CARET SAILS IN SUPERSONIC FLOW
L. H. Townsend London Aeron. Res. Council 1970 56 p refs Supersedes RAE-TR-67006; ARC-29541
(ARC-R/M-3624; RAE-TR-67006; ARC-29541) Copyright. Avail: NTIS; HMSO: £1.40; BIS: $5.40

For free stream Mach numbers between 10 and 4, a study is made of the profiles assumed and isentropic waves produced in nonviscous flows by two-dimensional sails, under pure tension

and of finite weight. At the higher free stream Mach numbers, large parts of the compression flow are virtually centered, and even for long sails (e.g. 100 ft chord) at a high Mach number (e.g. 10) and low stress (e.g. 5 tons/sq in), the weight of such a membrane need not exceed 1 lb/sq ft. The analysis is modified to include the effects of skin friction and is then extended to singly-curved caret sails, which allow leading edges to be swept but can still produce two-dimensional waves; while their curvature imparts to such sails a stiffness-due-to-shape, it is shown that equilibrium can alternatively be maintained by appropriately applied tensile forces. Rectangular and/or caret sails may find applications as wings, intakes, cowls, and nozzles for hypersonic vehicles. Author (ESRO)

N71-17108# Liverpool Univ. (England). Dept. of Mechanical Engineering.

A WIND-TUNNEL INVESTIGATION OF THE STALLING PERFORMANCE OF TWO COMPRESSOR CASCADES OF DIFFERENT ASPECT RATIOS AT LOW SPEED

M. R. A. Shaalan London Aeron. Res. Council 1970 41 p refs Sponsored jointly by Min. of Aviation and United Arab Rep. Govt. Supersedes ARC-30083
(ARC-CP-1103; ARC-30083) Copyright. Avail: NTIS; HMSO: 50p; BIS: $2.00

The blade section profile was staggered at 36 deg with a space-chord ratio of 0.88, and there was no tip clearance. Changes in aspect ratio were obtained by changing the blade chord only. The high aspect ratio blade (4.83) gave more deflection at mid-span near stall, but it stalled earlier and suddenly and the high pressure rise coefficient increased slightly with incidence up to the stall point. The low aspect ratio blade (2.10) stalled more progressively. The increase in axial velocity for both cascades was high, a greater spanwise contraction being evident for the low aspect ratio. The wall stall for the high aspect ratio blade was nearly equally distributed between the blade surface and the end wall, whilst it was shifted towards the blade surface for the other one. Author (ESRO)

N71-17109# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

ON LIFTING SURFACES SUPPORTING ONE OR MORE PLANE SHOCK WAVES

J. Pike London Aeron. Res. Council 1970 41 p refs Supersedes RAE-TR-66127; ARC-28452
(ARC-R/M-3623; RAE-TR-66127; ARC-28452) Copyright. Avail: NTIS; HMSO: £1.05; BIS: $3.78

Stream surfaces from the flow through a plane shock wave are used as compression surfaces to obtain higher lift to drag ratios than the two dimensional wedge ones. Two such compression surfaces can be combined into a W-Nonweiler shape, which gives in effect a central body below a swept wing. The viscous drag tends to be high, because the shapes have a large ratio of wetted area to plan area. For hypersonic speeds where the inviscid improvement over a two dimensional wedge is small, the high viscous drag puts the W-wings at a disadvantage compared with flat-bottomed configurations. At high supersonic speeds the inviscid improvement is more marked and a gain in performance, including viscosity, over that of the two dimensional wedge, and flat-bottomed shapes can be shown. For best performance the trailing edge of the W-wing is swept and its pressure drag and viscous drag are approximately equal. Author (ESRO)

N71-17112# Queen Mary Coll., London (England). Dept. of Aeronautical Engineering.

DELTA WINGS WITH LONGITUDINAL CAMBER AT LOW SPEED

R. K. Nangia and G. J. Hancock London Aeron. Res. Council 1970 29 p refs Supersedes ARC-31588
(ARC-CP-1129; ARC-31588) Copyright. Avail: NTIS; HMSO: 37.5p; BIS: $1.50

Comparison of experimental results for the streamwise lift distribution on a delta wing of aspect ratio 1 having various streamwise cambers with simplified slender linear theory was good even for large cambers, although linear theory is totally inadequate for total lift prediction. Author (ESRO)

N71-17113# Aircraft Research Association, Ltd., Bedford (England).

TESTS WITH A WING-MOUNTED FAN NACELLE WITH THE FAN JET SIMULATED BY COLD AIR BLOWING AND ALTERNATIVELY BY A GAS GENERATOR SHROUD Interim Report

G. Pauley London Aeron. Res. Council 1970 47 p refs Supersedes ARA-M-28/1; ARC-30158
(ARC-CP-1111; ARA-M-28/1; ARC-30158) Copyright. Avail: NTIS; HMSO: 70p; BIS: $2.80

Wind tunnel tests were made on a simulated high by-pass ratio fan engine mounted close to a wing to determine the interference effects in the Mach number range from 0.6 to 0.81. The nacelle and adjacent wing surfaces were fully pressure plotted and overall force measurements were obtained. Comparisons with test data from a free flow nacelle supported by a pylon suggests that the nacelle has a major influence on the local wing flow, whereas a pylon could be designed to have relatively little effect on this flow. Free flow nacelle effects were amplified by a cold fan jet. Attempts at reproducing the jet effects with a simple gas generator shroud were a complete failure. Author (ESRO)

N71-17114# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE ESTIMATION OF THE LOADING ON SWEPT WINGS WITH EXTENDING CHORD FLAPS AT SUBSONIC SPEEDS

J. McKie London Aeron. Res. Council 1970 45 p refs Supersedes RAE-TR-69034; ARC-31285
(ARC-CP-1110; RAE-TR-69034; ARC-31285) Copyright. Avail: NTIS; HMSO: 60p; BIS: $2.40

A method is given for estimating lift and vortex drag increments due to part span, extending chord flaps on thin, sweptback, tapered wings of large aspect ratio in inviscid, incompressible flow. This linear theory accounts for sweepback, tip, and center effects. Spanwise loadings are obtained by quadrature methods, extended to include discontinuities in wing chord, and examples are given for some typical wing and flap layouts. Author (ESRO)

N71-17117# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

EXPERIMENTAL INVESTIGATION OF THE EFFECT OF TRAILING-EDGE SWEEPBACK ON THE SUBSONIC LONGITUDINAL CHARACTERISTICS OF SLENDER WINGS

D. L. I. Kirkpatrick and A. G. Hepworth London Aeron. Res. Council 1970 33 p refs Supersedes RAE-TR-70039; ARC-32237
(ARC-CP-1130; RAE-TR-70039; ARC-32237) Copyright. Avail: NTIS; HMSO: 42.5p; BIS: $1.70

Measurements of the lift, drag, and pitching moment characteristics on three slender ogee wings with different trailing-edge sweepback angles are presented. The characteristics of these wings are correlated with those of wings with unswept trailing edges. Author (ESRO)

N71-17130*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF FLOW CHARACTERISTICS OF SOME WIRE-FORM AND LAMINATE-FORM POROUS MATERIALS

Albert Kaufman and Hadley T. Richards Washington Oct. 1970 23 p refs
(NASA-TM-X-2111; E-5748) Avail: NTIS CSCL 01A

Experimentally determined flow characteristics were correlated with standard flow rates and absolute filtration ratings of wire-form

materials and with functions of hydraulic diameters and external hole spacings of laminate-form materials. Effects on flow characteristics of specimen curvature and use of high temperature air up to 840 degrees F were investigated. The conclusion was drawn that flow rates both for elevated temperature conditions and for specimen curvatures simulating leading edge radii of turbine blades can be predicted with good accuracy from correlations developed and the basic flow equation for porous materials. Author

N71-17247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATIC-PRESSURE CONTOURS IN THE BLADE PASSAGE AT THE TIP OF SEVERAL HIGH MACH NUMBER ROTORS
Genevieve R. Miller and Everett E. Bailey Washington Feb. 1971 16 p refs
(NASA-TM-X-2170; E-5875) Avail: NTIS CSCL 01A

Static pressure contours across the blade passage at the tip of three high Mach number rotors are presented. Inlet relative Mach numbers vary from 1.23 to 1.59. Flow rates vary from near choke values to those near blade stall. Blade shapes include both double circular arc and multiple circular arc. The static pressure contour plots indicate the location of the passage shock waves over a range of Mach numbers and operating conditions. Qualitative comparisons of flow conditions through blade passages for the two blade shapes can be made. However, a quantitative analysis of the data is not attempted. Author

N71-17263*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF THE VIKING LANDER CAPSULE AT MACH 6
Theodore J. Goldberg and James C. Emery Washington Feb. 1971 18 p refs
(NASA-TM-X-2205; L-7516) Avail: NTIS CSCL 20D

An investigation of the longitudinal aerodynamic characteristics of a 0.0348-scale Viking lander capsule has been conducted at a Mach number of 6 and free-stream Reynolds numbers from 0.98 × 10 to the 7th power to 2.35 × 10 to the 7th power per meter. Data obtained at angles of attack from −3 deg to 20 deg were compared with analytical values obtained by the sine squared deficiency method and modified Newtonian theory. Author

N71-17364*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF SPECIFIC SPEED ON THE EXPERIMENTAL PERFORMANCE OF A RADIAL-INFLOW TURBINE
Milton G. Kofskey and William J. Nusbaum Washington Feb. 1971 29 p refs
(NASA-TN-D-6182; E-5928) Avail: NTIS CSCL 21E

A 4.97-inch(12.62-cm)tip diameter radial-inflow turbine was investigated over a range of specific speeds from 36 to 76 (rpm) at equivalent design speed and pressure ratio. This specific speed range was obtained by using stators with different throat areas. Each stator was tested with the unmodified or design rotor and with a rotor extension that reduced the rotor throat area to 53 percent of design. Results are presented to show the effect of the change in specific speed on turbine performance. Comparison is made between results obtained with the design rotor and with the rotor extension. Author

N71-17424*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VORTEX-LATTICE FORTRAN PROGRAM FOR ESTIMATING SUBSONIC AERODYNAMIC CHARACTERISTICS COMPLEX PLANFORMS
Richard J. Margason and John E. Lamar Washington Feb. 1971 141 p refs
(NASA-TN-D-6142; L-7262) Avail: NTIS CSCL 01A

A computer program was developed for estimating the subsonic aerodynamic characteristics of complex planforms. The program represents the lifting planform with a vortex lattice. The material presented is intended as a user's guide and includes a study of the effect of vortex lattice arrangement on computed results, several sample cases, and a listing of the FORTRAN computer program. Author

N71-17432# Advisory Group for Aerospace Research and Development, Paris (France).
MANUAL ON AEROELASTICITY: SUBJECT AND AUTHOR INDEX
E. C. Pike, ed. Jan. 1971 28 p refs
(AGARD-R-578-71) Avail: NTIS

The Subject Index and Author Index cover all the chapters in the six loose-leaf volumes of the Manual on Aeroelasticity and were up to date in April 1970. Since that date new chapters of the manual have been published in the AGARD Report series. The Indexes are published in two forms: in the AGARD Report series as AGARD Report 578 and in loose-leaf form for insertion in Volume VI of the Manual. Entries are given by volume, chapter and page number. For example, II/9/56 denotes Volume II, Chapter 9, page 56. The letter S after a chapter number denotes a supplement to that chapter. The letters TG denote the section of tables and graphs in Volume VI. The abbreviation INTRO denotes the introductory survey in Volume I. Author

N71-17468*# Scientific Translation Service, Santa Barbara, Calif.
THE AIRFOIL THEORY
Caius Jacob Washington NASA Feb. 1971 16 p refs Transl. into ENGLISH from Proceedings of the 8th Symp. on Advanced Probl. and Methods in Fluid Dyn., (Tarda), 18–25 Sep. 1967 p 35–43
(Contract NASw-2035)
(NASA-TT-F-13471) Avail: NTIS CSCL 20D

The thin airfoil theory is discussed by taking into account the solution of a harmonic Dirichlet problem for the complex plane. The function representing the solution of this problem is investigated. The results obtained make it possible to resolve directly the Dirichlet problem for the harmonic function considered. The explicit solution of the problem of the thin airfoil is discussed, and an example for the determination of the complex velocity is presented. Author

N71-17589*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TWO-DIMENSIONAL CASCADE TEST OF A JET-FLAP TURBINE ROTOR BLADE
Stanley M. Nocek and John F. Kline Washington Feb. 1971 18 p refs
(NASA-TM-X-2183; E-5989) Avail: NTIS CSCL 21E

A jet-flap turbine blade was tested in a two-dimensional cascade of six blades to study the effectiveness of the concept as a boundary-layer control device and as a variable-area device. Principal measurements were surveys of blade surface static pressure and blade exit total pressure, static pressure, and flow angle at midspan. Data were taken at constant pressure ratio for jet flows from 0 to 4 percent of primary flow. Results are presented in terms of primary flow, blade surface pressure distribution, blade specific force, kinetic energy loss coefficient, total pressure loss, and exit flow angle. Author

N71-17590*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF A TURBINE WITH TRANSPIRATION-COOLED STATOR BLADES. 2: PERFORMANCE OF STATOR WITH WIRE-MESH SHELL BLADING
Frank P. Behning, Herman W. Prust, Jr., and Thomas P. Moffitt Washington Feb. 1971 28 p refs
(NASA-TM-X-2166; E-5939) Avail: NTIS CSCL 21E

The effects on stator performance of transpiration coolant discharge from wire-mesh shell blading were experimentally determined for ratios of coolant flow to primary flow of 0 to 0.07. The results showed that transpiration coolant discharge from this type of blading caused an efficiency loss relative to comparable noncooled blading. The results for transpiration discharge from wire-mesh shell blading are similar to results previously obtained for transpiration discharge from discrete hole blading. A comparison of the effects on stator efficiency of transpiration discharge and trailing-edge discharge shows a significantly larger loss for transpiration discharge. Author

N71-17702 Stanford Univ., Calif.
AN EXPERIMENTAL STUDY OF THE EFFECTS OF LEADING-EDGE BLOWING UPON THE CHARACTERISTICS OF A JET-FLAPPED AIRFOIL
Timothy Wang (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-1624

The extent to which maximum lift and stalling angle can be increased by diverting a portion of the jet flap momentum efflux through a leading-edge blowing slot is discussed. The basic wing model tested has a 1 ft. chord, a 2 ft. span, a truncated NACA 0015 profile (thickness of 18 percent chord) and an 8.3 percent chord trailing-edge flap incorporating shroud blowing. Two nose configurations, one having a blowing slot at the leading edge and the other having a blowing slot at 1/2 percent chord, were tested with the model. A full span slide valve within the model enabled diversion of up to approximately 1/3 of the total jet momentum efflux through the nose slot. Substantial increases in stalling angle and maximum lift were achieved with the incorporation of leading-edge blowing. For the same total jet momentum coefficient, flap deflection, and angle of attack, the addition of leading-edge blowing was found to increase the nose-down quarter chord pitching moment, the fraction of jet momentum recovered as thrust, and the lift of a jet-flapped airfoil. Dissert. Abstr.

N71-17733# Naval Weapons Lab., Dahlgren, Va.
ON RESONANCE INSTABILITY FOR FINNED CONFIGURATIONS HAVING NON-LINEAR AERODYNAMIC PROPERTIES
Thomas A. Clare Oct. 1970 51 p refs
(AD-715110; NWL-TR-2473) Avail: NTIS CSCL 20/4

An approximate solution is presented for the angular motion, at and near resonance, of finned configurations (with small aerodynamic asymmetries) having non-linear aerodynamic properties. An extension of the Method of Slowly Varying Parameters (or Averaging Method) is used to solve the simultaneous pitch and yaw equations of motion, in terms of amplitude-rate equations, at the resonance point. Included in this analysis are the non-linear variations of the restoring, damping, and Magnus moments with angle of attack. Both transient and steady state solutions are obtained. A detuning of the rolling velocity from its resonant value is performed to yield a solution in the critical near-resonant region. This result is shown to give rise to the well-known resonance jump in the steady state case. Finally, allowing the detuning parameter to vary with time enables an examination of the non-linear catastrophic yaw problem in which both the rolling velocity and the roll orientation angle may vary with time. In this regard, the effects of a non-linear variation of the induced side moment with angle of attack are determined. The accuracy of these solutions is evaluated by comparison with exact numerical integrations of the equations of motion. Author (GRA)

N71-17877*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN EXPERIMENTAL INVESTIGATION OF THE AIRFLOW OVER A CAVITY WITH ANTIRESONANCE DEVICES
Donald A. Buell Washington Mar. 1971 72 p refs
(NASA-TN-D-6205; A-3691) Avail: NTIS CSCL 20D

Airflow over deep cavities was investigated in a wind tunnel and in flight at high subsonic speeds at equivalent or actual altitudes of 7 to 12 km. The cavities were large, with opening dimensions on the order of 1 m. Pressures were measured in and near the cavities with and without externally mounted devices intended to suppress resonances in the cavities. Some of the devices reduced the pressure fluctuations from as much as 50 to 2 or 3 times the amplitude occurring in a normal attached boundary layer. The pressure data were analyzed for spectral content, coherence, phase, shear-layer thickness, and shear-layer location. Author

N71-17882*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERALL PERFORMANCE IN ARGON OF A 3.7-INCH SIX-STAGE AXIAL-FLOW COMPRESSOR
Edward R. Tysl, Laurence J. Heidelberg, and Carl Weigel Washington Mar. 1971 23 p refs
(NASA-TM-X-2194; E-5522) Avail: NTIS CSCL 21E

Overall performance from the compressor inlet to the collector exit and overall performance from the compressor inlet to the exit of the sixth-stage stator are presented as a function of equivalent weight flow. Peak efficiency (compressor inlet to collector exit) was 0.755 at the design equivalent rotative speed of 49,213 rpm and occurred at an equivalent weight flow of 1.55 lb/sec (0.70 kg/sec). The pressure ratio at peak efficiency was 2.72. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N71-18904# TRW Systems Group, Redondo Beach, Calif.
HIGH-SPEED GROUND TRANSPORTATION SYSTEMS ENGINEERING STUDY: TRACKED AIR CUSHION VEHICLE SYSTEMS Final Report
May 1970 623 p refs
(Contract DOT-C-353-66)
(PB-195030; TRW-06818-6039-R0-00; FRA-RT-71-59) Avail: NTIS HC $10.00/MF $0.65 CSCL 13F

The tracked air cushion vehicle is one of several advanced ground transportation systems being studied as a possible means of providing safe, high-speed, high-capacity transportation along densely populated areas. Based on requirements and constraints chosen for an operational system, subsystem alternatives are evaluated and the selected subsystems are synthesized into a TACV system. Cost and performance are estimated over a range of

parameters, such as design cruise speed (150 to 350 mph) and vehicle capacity (50 to 150 passengers per vehicle). The configuration defined consists of trainable, electrically powered TACV's which collect power from trackside power rails mounted on the side of a channel guideway. Propulsion is by linear induction motors with variable frequency speed control. Control of the vehicles, singly or in trains, is automated and centralized. The vehicles are supported on and guided by peripheral jet air cushions with high pressure air provided by electrically driven axial flow compressors.
Author (GRA)

N71-16983# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYTICAL SOLUTIONS FOR THE CASE OF FLYING VEHICLE MOTION AT LOW ANGLES OF ATTACK. CHAPTER 8. 32: PLANE MOTION, DETERMINATION OF THE TIME OF TRANSITION OF ROTATIONAL INTO VIBRATIONAL MOTION
G. E. Kuzmak [1970] 8 p refs Transl. into ENGLISH from the book "Dinamika Neupravliaemogo Dvizheniia Letatelnykh Apparatov pri Vkhode v Atmosferu" Moscow, Nauka Press, 1970 p 297–307
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Considered are cases of motion when the equation for the angle of attack on the EE' section of the trajectory directly abutting on the boundary of the atmosphere has an exact solution expressed in terms of Bessel functions. The motion must occur at low angles of attack. This assumes compliance with definite demands on the approach of a flying vehicle to the boundary of the atmosphere. Solutions expressed in terms of Bessel functions allow clarification of a number of motion details when the angular velocity of the flying vehicle outside the atmosphere is quite low.
Author

N71-17063# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: COMPANIA DOMINICANA DE AVIACION DOUGLAS DC-4, CARVAIR ATL 98, HI-168 NEAR MIAMI INTERNATIONAL AIRPORT, MIAMI, FLORIDA, 23 JUNE 1969
12 Aug. 1970 34 p
(NTSB-AAR-70-17; SA-415) Avail: NTIS

Dominicana Airlines, Flight 401, a DC-4, operating as a cargo flight from Miami, Florida, to Santo Domingo, Dominican Republic, crashed shortly after takeoff from Miami International Airport on June 23, 1969. The aircraft was destroyed by impact and the ensuing ground fire. Several buildings in the area of the accident site were also damaged. The four occupants of the aircraft, as well as six persons on the ground, were fatally injured. The Safety Board determined that the probable cause of the accident was the confused action on the part of the crew while attempting to cope with the catastrophic failure of an engine during takeoff.
Author

N71-17082# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
LOW SPEED FLIGHT TESTS ON A TAILLESS DELTA WING AIRCRAFT (AVRO 707B). PART 4: WING FLOW
D. H. Perry, W. G. A. Port, and J. C. Morrall London Aeron. Res. Council 1970 52 p refs Supersedes RAE-AERO-2639; ARC-22256
(ARC-CP-1107-Pt-4; RAE-AERO-2639-Pt-4; ARC-22256-Pt-4) Copyright. Avail: NTIS; HMSO: 50p; BIS: $2.00

Flow visualization tests showed that the growth of the separated area occurred by progressive inboard movement of a separation boundary which lay roughly chordwise across the wing so accounting for most of the changes in the aerodynamic characteristics of the aircraft at high incidence. Attempts to reduce the longitudinal instability caused by the flow separation with wing fences and a notch were unsuccessful.
Author (ESRO)

N71-17083# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
LOW SPEED FLIGHT TESTS ON A TAILLESS DELTA WING AIRCRAFT (AVRO 707B). PART 3: LATERAL STABILITY AND CONTROL
D. H. Perry, J. C. Morrall, and W. G. A. Port London Aeron. Res. Council 1970 80 p refs Supersedes RAE-AERO-2638; ARC-22242
(ARC-CP-1106-Pt-3; RAE-AERO-2638-Pt-3; ARC-22242-Pt-3) Copyright. Avail: NTIS; HMSO: 85p; BIS: $3.40

Measurements of the aileron and rudder powers enabled the sideslip and damping derivatives to be determined. The control powers and sideslip derivative measurements agreed with wind tunnel measurements, and high lift coefficient changes were consistent with smoke and tuft wing flow studies. The derivatives were used to estimate the period, damping and roll-yaw ratio of the lateral oscillation which agreed with the flight measurements.
Author (ESRO)

N71-17084# National Gas Turbine Establishment, Pyestock (England).
INGESTION OF DEBRIS INTO INTAKES BY VORTEX ACTION
D. E. Glenny London Aeron. Res. Council 1970 47 p refs Supersedes NGTE-R-307; ARC-31474
(ARC-CP-1114; NGTE-R-307; ARC-31474) Copyright. Avail: NTIS; HMSO: 48p; BIS: $2.40

The impulsive lifting of particles by the ground-to-intake vortex core is considered both theoretically and experimentally. For a given inlet velocity the strength of the vortex and the maximum size of particle that can be lifted depends on ambient vorticity and the strength of the wind blowing on to the intake. Various methods of reducing ingestion were examined but none provided an absolute safeguard. However, a progressive opening of the throttle as the aircraft initially accelerates, may reduce the ingestion problem.
Author (ESRO)

N71-17102# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
THE CONTROL CHARACTERISTICS OF AIRCRAFT EMPLOYING DIRECT-LIFT CONTROL
W. J. G. Pinsker London Aeron. Res. Council 1970 61 p refs Supersedes RAE-TR-68140; ARC-30835L
(ARC-R/M-3629; RAE-TR-68140; ARC-30835) Copyright. Avail: NTIS; HMSO: £1.50; BIS: $5.40

The theory is developed for the control characteristics of aircraft in which direct lift is commanded directly by the pilots' stick. Basic requirements are established for acceptable response characteristics; of particular importance is the location at which direct lift acts relative to the center of gravity, the aerodynamic center, and maneuver point. The line of action of the control lift can be controlled by mechanical interconnections between the conventional pitch control and direct lift systems. Potential benefits of direct lift control include improved precision in landing large aircraft, more effective control of gust effects, and reduced possibility of stalling.
Author (ESRO)

N71-17119# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
SUPER VC 10 CRUISE DRAG: A WIND TUNNEL INVESTIGATION. PART 1: EXPERIMENTAL TECHNIQUES

C. R. Taylor, J. R. Hall, and R. W. Hayward London Aeron. Res. Council 1970 44 p refs Supersedes RAE-TR-69180; ARC-31771
(ARC-CP-1125; RAE-TR-69180; ARC-31771) Copyright. Avail: NTIS; HMSO: 60p; BIS: $2.40

Measurements were made of the longitudinal forces and moments on a 1/27 scale model of the Super VC 10 at Mach numbers between 0.60 and 0.86. The model design, test techniques and corrections, and the measuring techniques are discussed. Author (ESRO)

N71-17119# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
FREQUENCY DISTRIBUTIONS AND EXTREME VALUES OF THE CENTER OF GRAVITY ACCELERATION AND OF THE STRESS ON LOWER WING SURFACE OF A BOEING 720-B [HAEUFIGKEITSVERTEILUNGEN UND EXTREMWERTE DER SCHWERPUNKTSBESCHLEUNIGUNG UND DER SPANNUNG AN DER FLUEGELUNTERSEITE EINER BOEING 720-B]
O. Buxbaum Fraunhofer Ges. Mar. 1970 44 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verkehr
(TB-87-1970) Avail: NTIS

In order to evaluate the effects of gust load seasonal variations on airframes the following parameters were recorded continuously during 571 flights of a Boeing 720-B airplane during normal service and analyzed statistically: vertical acceleration near center of gravity, lower wing in-spar skin stress, pressure altitude and air-speed, airplane takeoff and landing weights, and flight duration. Author (ESRO)

N71-17131*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONVECTIVE HEAT TRANSFER TO THE AMES M2 AND M2-F2 LIFTING ENTRY VEHICLES
H. Lee Seegmiller Washington Dec. 1968 83 p refs
(NASA-TM-X-1691) Avail: NTIS CSCL 01C

The convective heat transfer to the M2 and M2-F2 lifting entry vehicles has been measured at angles of attack from minus 7 degrees to plus 77 degrees during tests at hypersonic Mach numbers. Heating of the configuration is generally concentrated at the nose, pitch control, and fin leading edges at low angles of attack and at the lower surface, pitch control, and extended rudders at high angles of attack. Three dimensional separated flow occurred in the region of the lower pitch controls and extended rudders in all tests at the lower angles of attack. Author

N71-17132*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
BASE PRESSURE MEASUREMENTS ON THE XB-70 AIRPLANE AT MACH NUMBERS FROM 0.4 TO 3.0
Edwin J. Saltzman, Sheryll A. Goecke, and Chris Pembo Washington Sep. 1968 36 p refs
(NASA-TM-X-1612) Avail: NTIS CSCL 01C

Full-scale flight base pressure coefficients obtained from the XB-70 propulsion package are compared with predicted values based on a combination of cold jet flow wind-tunnel models and data from a two-engine side-by-side jet, full scale aircraft. At cruise Mach numbers the base pressures on the full-scale aircraft were higher than predicted, resulting in a favorable increment of about two percent in terms of lift-drag ratio. At low supersonic speeds near a Mach number of 1.2, the negative base pressure coefficients were about three times larger than predicted, resulting in a significant lift-drag ratio decrement. Author

N71-17144# National Physical Lab., Teddington (England). Hovercraft Unit.
THE CORRECTION OF HOVERCRAFT PERFORMANCE TO STANDARD CONDITIONS
J. C. Shipway Sep. 1970 54 p refs
(NPL-Hovercraft-16) Copyright. Avail: NTIS

Coefficients, derived from trials with four different hovercraft types, for correcting hovercraft performance to assumed standard conditions are discussed. The results suggest that craft performance is best compared on the basis of achieved Froude number versus (observed wave height/overall craft length). Author (ESRO)

N71-17145# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
SYNOPTIC AEROLOGICAL CONDITIONS FOR THE OCCURRENCE OF CLEAR AIR TURBULENCE [DIE SYNOPTISCHAEROLOGISCHEN BEDINGUNGEN FUER DAS AUFTRETEN VON CLEAR-AIR-TURBULENZ]
Friedhold Weber Aug. 1970 113 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-29) Avail: NTIS; ZLDI Munich: 34.50 DM

After a literature review the results of Lufthansa North Atlantic jet stream clear air turbulence (CAT) observations are given. Vertical acceleration was related to certain meteorological situations and different atmospheric parameters. Special synoptic aerological conditions during which moderate or severe CAT can be expected are discussed. Author (ESRO)

N71-17160# National Physical Lab., Teddington (England). Hovercraft Unit.
MOVEMENT OF HIGH DENSITY LOADS
A. T. A. Wride Jul. 1970 34 p
(NPL-Hovercraft-TM-31) Copyright. Avail: NTIS

High density loads can be moved over 1 in. obstacles using fingered skirts giving a hoverheight of 2 in. and cushion pressures up to 5 p.s.i. Author (ESRO)

N71-17161# National Physical Lab., Teddington (England). Hovercraft Unit.
A COMPARISON OF THE CRUISE EFFICIENCY AND RANGE OF MARINE VEHICLES AND AIRCRAFT
J. R. Bishop Jun. 1970 36 p refs
(NPL-Hovercraft-12) Copyright. Avail: NTIS

The discussion also includes jet aircraft which are often excluded from comparisons with marine vehicles because their shaft power is not known. Data are also presented for ships, aircraft, hovercraft, hydrofoils, and helicopters. High speed marine vehicles have cruise efficiencies considerably lower than those of aircraft due to inferior lift-drag ratio and propulsive efficiency. Author (ESRO)

N71-17415*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DAMPING AND OSCILLATORY STABILITY IN PITCH AND YAW OF A VARIABLE-SWEEP SUPERSONIC TRANSPORT CONFIGURATION AT MACH NUMBERS FROM 0.40 TO 1.80
Robert A. Kilgore Washington Feb. 1971 30 p refs
(NASA-TM-X-2164; L-7429) Avail: NTIS CSCL 01C

Wind-tunnel measurements have been made with wing leading-edge sweep angles of 25 deg at Mach numbers of 0.40 and 0.80, 50 deg at Mach numbers of 0.80, 0.90, 1.00, and 1.20, and 75 deg at a Mach number of 1.80. The investigation was made at an oscillation amplitude of about 1 deg by using a forced-oscillation technique. The effects of horizontal and vertical

tails, as well as the effect of horizontal-tail height, were investigated. The engine inlets were blocked since internal flow through the engines could not be simulated. In order to determine qualitatively the effect of blocking the engine inlets, tests were also made with a configuration having an ogive nose. Author

N71-17423*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT INVESTIGATION OF A V/STOL TRANSPORT MODEL WITH FOUR POD-MOUNTED LIFT FANS
William J. Newsom, Jr. and Sue B. Grafton Washington Feb. 1971 32 p refs
(NASA-TN-D-6129) Avail: NTIS CSCL 01C

The investigation consisted of free-flight model tests in hovering and forward flight through the transition speed range up to the point where conversion would be wingborne flight. Dynamic stability characteristics of the model were also calculated for correlation with flight results. Because of a small static margin and speed instability, artificial damping in pitch was needed to obtain satisfactory pitch characteristics. No problem was experienced with roll or yaw through the transition speed range. Author

N71-17425*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME TRANSONIC AND SUPERSONIC DYNAMIC STABILITY CHARACTERISTICS OF A VARIABLE-SWEEP-WING TACTICAL FIGHTER MODEL
Robert A. Kilgore Washington Feb. 1971 45 p refs
(NASA-TM-X-2163; L-7428) Avail: NTIS CSCL 01C

Wind-tunnel tests were made by using a small-amplitude forced-oscillation mechanism to determine the damping and oscillatory stability in pitch and in yaw and the effective-dihedral parameter at angles of attack from about −5 deg to 17 deg at Mach numbers from 0.40 to 2.50. The effect of individual model components, tail incidence, and wing-sweep angle was investigated. The data are presented without analysis. Author

N71-17426*# Boeing Co., Seattle, Wash.
STUDY AND DEVELOPMENT OF TURBOFAN NACELLE MODIFICATIONS TO MINIMIZE FAN-COMPRESSOR NOISE RADIATION VOLUME 6: SONIC INLET DEVELOPMENT
Contractor Report, 1 May 1967 – 1 Nov. 1969
Washington NASA Jan. 1971 121 p
(Contract NAS1-7129)
(NASA-CR-1715) Avail: NTIS CSCL 01C

Several sonic throat inlet concepts were investigated as a means of reducing the forward-radiated fan noise of turbofan JT3D-powered 707-320B/C airplanes. The acoustic, internal aerodynamic, and operational characteristics of a selected contracting cowl inlet were evaluated in model and full-scale ground rig tests. Statis and in-flight inlet operation was simulated for both the noise-suppressed and unsuppressed modes of operation. Tests were conducted for a range of engine speeds, inlet Mach numbers, throat areas, and boundary-layer control configurations with both fixed and variable geometry inlets. Results are presented for fan noise attenuation, Mach number distributions, total and static pressure recovery, and effects on engine operation. Results are shown also for the dynamic response characteristics of the inlet and engine while operating with the inlet under automatic control. At simulated landing approach conditions, the results indicate that a 14- to 16-PNdB reduction of fan noise from the inlet was achieved with inlet center line Mach numbers of 0.7 to 0.8. Principal airplane performance penalties appear to be associated with the increased weight and drag of the acoustic nacelles. Author

N71-17433*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR STUDY OF FLIGHT CHARACTERISTICS OF A JET-FLAP STOL TRANSPORT AIRPLANE DURING APPROACH AND LANDING
William D. Grantham, Robert W. Sommer, and Perry L. Deal Washington Feb. 1971 42 p refs
(NASA-TN-D-6225; L-7582) Avail: NTIS CSCL 01C

A fixed-base simulator study was conducted to provide a preliminary determination of the low-speed handling qualities of a STOL transport configuration equipped with an external-flow jet flap and high-bypass-ratio turbofan engines. Real-time digital simulation techniques were used. The computer was programmed with equations of motion for six degrees of freedom and the aerodynamic inputs were based on measured wind-tunnel data. A visual display of a STOL airport was provided for simulation of the flare and touchdown characteristics. The primary piloting task was an instrument approach to a breakout at a 200-foot ceiling, with a visual landing. Author

N71-17441*# Scientific Translation Service, Santa Barbara, Calif.
ESTABLISHMENT OF TAKE-OFF AND LANDING SAFETY MARGINS FOR THE BREGUET 941 [ESTABLISSMENT DES MARGES DE SECURITE AU DECOLLAGE ET A L'ATTERRISSAGE POUR LE BREGUET 941]
J. Bastidon Washington NASA Feb. 1971 15 p Transl. into ENGLISH from Proc. of the 37th Meeting of the AGARD Flight Mech. Panel, (Baden Baden), 20 – 23 Oct. 1970 6 p
(Contract NASw-2035)
(NASA-TT-F-13483) Avail: NTIS CSCL 01C

Two types of safety margins are considered: (1) speed margins (take-off speed and approach speed), and (2) field length margins. These two types of margins are examined and discussed from the point of view of one individual aircraft, the BR 941. The establishment of these margins depends on theoretical consideration, results of in-flight measurements, and operational tests. Discussions with the F.A.A. are also taken into consideration with respect to establishing special considerations for civil certification of this aircraft. Author

N71-17478# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORTS: BRIEF FORMAT: US CIVIL AVIATION, ISSUE NO. 5: 1969 ACCIDENTS
Nov. 1970 450 p
(NTSB-BA-70-5) Avail: NTIS; HC$6.00/MF$0.95

Statistical tables and accident briefs are presented on general aviation and supplemental air carrier accidents. N.E.N.

N71-17479# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: TEXAS INTERNATIONAL AIRLINES, INCORPORATED, DOUGLAS DC-9, N1306T, HARLINGEN, TEXAS, 11 JANUARY 1970
2 Dec. 1970 25 p refs
(NTSB-AAR-70-28) Avail: NTIS

The investigation report is presented for the accident in which the aircraft struck a tree and two power poles 12,000 feet short of the runway threshold during a predawn instrument approach in fog. It was concluded that the probable cause was the continuation of descent through the minimum descent altitude as a result of inadequate crew monitoring of altimeters. Contributing factors were a lack of awareness of the actual meteorological conditions, caused by crew fatigue, and company workload priorities which prevented normal communications and deferred the dissemination of essential meteorological information. Author

N71-17511# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: EXECUTIVE JET AVIATION INCORPORATED LEAR JET L23A, N434EJ NEAR THE EMMET COUNTY AIRPORT PELLSTON, MICHIGAN, 9 MAY 1970
22 Dec. 1970 31 p ref
(NTSB-AAR-71-3) Avail: NTIS

On May 9, 1970, Lear Jet N434EJ, operated by Executive Jet Aviation, Inc., was on a nonscheduled air taxi flight from Detroit, Michigan to Pellston, Michigan. The aircraft crashed at approximately 2128 during an instrument approach to the Emmet County Airport at Pellston. Both crewmembers and the four passengers aboard received fatal injuries. The aircraft made initial contact with trees on a hill located approximately 2-1/4 miles southwest of the approach end of Runway 5. A swath approximately 45 feet wide and 254 feet long, on a true heading of 107 deg, had been cut through the trees by the aircraft. The highest mean sea level (m.s.l.) elevation of the trees at the break points was 886 feet. The Board determines the probable cause of this accident to be illusions produced by the lack of visual cues during a circling approach over unlighted terrain at night to a runway not equipped with approach lights or other visual approach aids. These illusions, which made the pilot think that he was higher than his true position, were made more acceptable to him because of a strong possibility of an erroneously high indication on his altimeter. Author

N71-17512# National Transportation Safety Board, Washington, D.C.
AIRCRAFT ACCIDENT REPORT: NORTH CENTRAL AIRLINES, INCORPORATED, CONVAIR 580, N2045, O'HARE INTERNATIONAL AIRPORT, CHICAGO, ILLINOIS, 27 DECEMBER 1968
12 Nov. 1970 52 p
(NTSB-AAR-70-27) Avail: NTIS

North Central Airlines, Flight 458, a Convair 580, crashed while it was on an instrument approach at O'Hare International Airport, Chicago, Illinois, at approximately 2022 c.s.t., on December 27, 1968. The aircraft struck the side of a hangar, located adjacent to the approach end of the runway, in a near-inverted attitude, and was destroyed by impact and resultant ground fire. Twenty-seven of the 45 persons on board the aircraft, including the pilot, copilot, and an additional crewmember who was occupying the observer's seat, were fatally injured. One person in the hangar also received fatal injuries as a result of the accident. The National Transportation Safety Board determines that the probable cause of this accident was spatial disorientation of the captain precipitated by atmospheric refraction of either the approach lights or landing lights at a critical point in the approach wherein the crew was transitioning between flying by reference to flight instruments and by visual reference to the ground. Author

N71-17545# Department of Transportation, Washington, D.C. Office of Supersonic Transport Development.
SUPERSONIC TRANSPORT DEVELOPMENT ENVIRONMENTAL IMPACT STATEMENT
7 Dec. 1970 34 p
Avail: NTIS

A discussion is presented concerning the knowledge that is now possessed and that which will be required in order to determine the environmental impact of supersonic transports. Current research directed at the major environmental concerns is briefly summarized and covers the following areas: (1) airport and community noise, (2) weather and climate modification, (3) cosmic radiation, and (4) sonic booms. The present status of U.S. plans for development of the SST is reviewed and alternatives for future direction of efforts are discussed. D.L.G.

N71-17553# Federal Aviation Administration, Washington, D.C. Flight Standards Service.
TENTATIVE AIRWORTHINESS STANDARDS FOR POWERED LIFT TRANSPORT CATEGORY AIRCRAFT
Aug. 1970 144 p
Avail: NTIS

Tentative airworthiness standards are presented which are intended for study, trial application, and comment during the design and development of vertical and other powered lift aircraft. Because of the wide variety of novel features of these emerging aircraft and lack of experience in their certification and operation, the proposed standards are not expected to be appropriate for all designs. However, the tentative standards are aimed at providing useful guidelines for designers and the FAA in arriving at the acceptable level of airworthiness. Author

N71-17591*# Boeing Co., Seattle, Wash.
STUDY AND DEVELOPMENT OF TURBOFAN NACELLE MODIFICATIONS TO MINIMIZE FAN-COMPRESSOR NOISE RADIATION. VOLUME 2: ACOUSTIC LINING DEVELOPMENT, 1 MAY 1967 – 1 NOVEMBER 1969
Washington NASA Jan. 1971 184 p refs
(Contract NAS1-7129)
(NASA-CR-1712) Avail: NTIS CSCL 01B

An acoustic lining development program is described, which covers selection of facing materials and lining concepts suitable for attenuating turbofan engine noise generated by a fan compressor and development of acoustic lining design technology. A theoretical method for predicting lining attenuation in a duct without airflow is presented and is combined with an empirical prediction method developed from parametric results of the flow-duct tests to establish a lining design procedure. Concurrent and interrelated investigations, which comprised the acoustic lining development program, are described as is the facilities equipment used. Evaluation of more than 40 types of acoustic facing materials resulted in the selection of woven metallic fiber, metallic felt, reinforced metallic felt, and resin impregnated fiberglass laminate facing materials as most suitable for acoustic linings in a turbofan nacelle environment. A study of lining concepts resulted in selecting a broadband resistive-resonator type lining as best suiting engine-fan-duct and inlet-installation requirements. Results are presented of analytical and experimental investigations undertaken to develop an acoustic lining design procedure and to select suitable lining concepts and materials for reducing fan-compressor-generated noise in turbofan engines. A comprehensive acoustic-lining flow-duct test program established the parameters controlling the amount and peak frequency of attenuation provided by a lining. Test results also showed metallic and nonmetallic linings, having the same flow resistance and geometry, provide similar attenuation characteristics. Author

N71-17668*# Boeing Co., Seattle, Wash.
STUDY AND DEVELOPMENT OF TURBOFAN NACELLE MODIFICATIONS TO MINIMIZE FAN-COMPRESSOR NOISE RADIATION. VOLUME 4: FLIGHTWORTHY NACELLE DEVELOPMENT, 1 MAY 1967 – 1 NOVEMBER 1969
Washington NASA Jan. 1971 192 p refs
(Contract NAS1-7129)
(NASA-CR-1714) Avail: NTIS CSCL 01B

A flightworthy configuration of the treated inlet and fan exhaust duct resulted from further development of acoustic, aerodynamic, and structural design of the nacelle concept developed and tested. Both the design and manufacturing processes that developed placed performance goal achievement above minimum weight considerations. The estimated airplane empty weight increase of a weight-oriented production design is 3140 lb. Four nacelles were fabricated and each was subjected to ground calibration testing. Compared to baseline ground test results of an existing 707

airplane nacelle, static takeoff thrust of the flighworthy nacelle was shown to be essentially unchanged, with 2 percent less fuel consumption at cruise. Attainment of the 15-PNdB reduction in perceived noise level set as a program goal for flight operations was indicated. Author

N71-17783# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.

AN INVESTIGATION OF THE TRAILING VORTEX SYSTEM GENERATED BY A JET-FLAPPED WING OPERATING AT HIGH WING LIFT COEFFICIENTS Final Report

Barnes W. McCormick and William J. Schumacher Wright-Patterson AFB, Ohio AFFDL 5 Jun. 1970 48 p refs

(Contract F33615-69-C-1165)

(AD-715315; AFFDL-TR-70-90) Avail: NTIS CSCL 1/3

The purpose of the investigation was to measure the geometry of the trailing vortex generated behind a jet-flapped wing. Such vortices can pose a serious hazard to aircraft that penetrate them. Previous investigations performed on conventional wings indicate that these vortices persist for some time and have maximum tangential velocities which increase linearly with the lift coefficient. As future aircraft may employ high lift devices such as jet-flapped wings, the vortices generated could be even stronger. Two semispan models of a jet-flapped wing were tested in a subsonic wing tunnel. Parameters varied during testing included the jet flap angle, angle of attack, aspect ratio, and jet momentum coefficient. Vortex measurements were obtained using a vortex meter which measured the rotational speed of the fluid within the vortex. Values obtained were numerically integrated to yield the tangential velocity and circulation distributed through the vortex. Experimental results indicate that the maximum tangential velocity increases to a maximum and then decreases with continually increasing jet blowing. At high values of jet blowing, the vortex was found to decay rapidly downstream. Author (GRA)

N71-17792# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

AN IN-FLIGHT INVESTIGATION OF LATERAL-DIRECTIONAL DYNAMICS FOR THE LANDING APPROACH Final Technical Report

G. Warren Hall and Edward M. Boothe Wright-Patterson AFB, Ohio AFFDL Oct. 1970 288 p refs

(Contract F33615-69-C-1664)

(AD-715317; CAL-BM-2821-F-5; AFFDL-TR-70-145) Avail: NTIS CSCL 1/3

Lateral-directional handling qualities and roll control power requirements for executive jet and military Class II Airplanes in the landing approach flight phase were investigated in the variable stability T-33 airplane. Particular emphasis was placed on the effects of crosswinds and turbulence. Simulated IFR ILS approaches and VFR offset and crosswind approaches were made. Specifically, two Dutch roll frequencies, three Dutch roll damping ratios, three roll-to-sideslip ratios and three roll mode time constants were investigated. It was found that lateral-directional dynamics do not establish a limiting crosswind value; however, they do determine the ease or difficulty with which a crosswind approach can be accomplished. Roll control power requirements were determined from actual control usage data obtained throughout the evaluation program. In addition, a number of configurations were reevaluated with limited roll control power to determine minimum acceptable levels. Available roll control power can establish a limiting crosswind component. A number of configurations were evaluated with a stick controller in place of the normally used wheel controller to determine if the type of controller affected the lateral-directional dynamics for acceptable handling qualities. No difference was found to exist. A detailed comparison with MIL-F-8785B(ASG) requirements is included and generally shows the present requirements to be too conservative in the landing approach flight phase. Author (GRA)

N71-17854# Naval Aerospace Medical Inst., Pensacola, Fla.

ORIENTATION-ERROR ACCIDENTS IN REGULAR ARMY HU-1 AIRCRAFT DURING FISCAL YEAR 1967: RELATIVE INCIDENCE AND COST

W. Carroll Hixson, Jorma I. Niven, and Emil Spezia 25 Aug. 1970 38 p refs

(AD-715107; NAMRL-1108; USAARL-71-1) Avail: NTIS CSCL 1/2

The report dealing with the magnitude of the pilot disorientation/vertigo accident problem in Regular Army UH-1 helicopter operations. Incidence and cost data presented for fiscal year 1967 include a total of 50 major and minor orientation-error accidents (15 of which were fatal), resulting in 38 fatalities, 88 nonfatal injuries, and a total UH-1 aircraft damage cost of $7,542,177. Author (GRA)

N71-17908# Office of Naval Research, London (England).

THIRD INTERNATIONAL CONFERENCE ON RAIN EROSION AND ASSOCIATED PHENOMENA

E. I. Salkovit 20 Oct. 1970 31 p Conf. held at Hartley Wintney, Engl., 11–13 Aug. 1970

(AD-715100; C-25-70) Avail: NTIS CSCL 1/3

Equipment was described to test rain, hail and sand erosion damage to aircraft components flying at sub- and supersonic velocities. Materials were evaluated in terms of such meteorological exposure, and appropriate modeling techniques were described. Analyses were given of various factors influencing rain erosion resistance and investigations were conducted on the nature and consequences of raindrop disintegration on impact. Author (GRA)

N71-17907# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

HELICOPTER APPLICATION STUDIES OF THE VARIABLE DEFLECTION THRUSTER JET FLAP Final Report

Ronald G. Bailey and Jeffrey M. Hammer Nov. 1970 117 p refs

(Contract N00014-69-C-0267)

(AD-715071; Doc-12153-FR1(R)) Avail: NTIS CSCL 1/3

The results of an analytical study to determine the application of a blown flap device called the Variable Deflection Thruster (VDT) to a helicopter rotor are presented and analyzed. The study is part of a longer-range program to investigate and develop control techniques for stabilization of the higher harmonic modes of helicopter rotor blades. A high-speed digital computer program was used to calculate the aerodynamic characteristics and performance of a Sikorsky CH-34 rotor system as though equipped with a blown two-dimensional section. The study was made over a range of rotor flight profiles and operating parameters including advance ratio, shaft angle of attack, blade pitch, tip Mach number, jet deflection angle and blowing rate. Performance of the blown rotor is compared to the conventional CH-34 rotor to illustrate VDT application effectiveness. Results show that the operating lift capability and propulsive force of the CH-34 rotor are increased when the rotor is equipped with a blown device. A preliminary analysis of the attenuation of rotor hub-shear variation by programmed blowing is also shown. In all cases, improved performance through application of blown control requires additional power. Author (GRA)

N71-17909# Army Foreign Science and Technology Center, Washington, D.C.

PRACTICAL AERODYNAMICS OF THE MI-6 HELICOPTER

M. S. Yatsunovich 2 Nov. 1970 212 p Transl. into ENGLISH from THE PUBL 'Prakticheskaya Aerodinamika Vertoleta Mi-6' Moscow, Moscow Transport, 1969

(AD-714915; FSTC-HT-23-1172-70) Avail: NTIS CSCL 1/1

The book presents a brief description of the helicopter, the aerodynamics of its lifting system and fuselage, characteristics

of the D-25V gas turbine engine and the pitch-gas system. The basic flying modes of the helicopter, methods for performing them and flying limitations for the Mi-6 helicopter with trapezoidal and rectangular lifting rotor blades, as well as problems of balancing, control centering and stability of the helicopter and special cases in flight are analyzed. The diagrams of forces in flying modes with forward speed are presented for simplicity without considering banking or slipping with which the helicopter should be balanced. These problems are discussed in the analysis of balancing of the helicopter. Author (GRA)

N71-17951*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

ACOUSTIC ATTENUATION DETERMINED EXPERIMENTALLY DURING ENGINE GROUND TESTS ON THE XB-70 AIRPLANE AND COMPARISON WITH PREDICTIONS

Norman J. McLeod Washington Mar. 1971 15 p refs
(NASA-TM-X-2223; H-633) Avail: NTIS CSCL 01C

Acoustic data obtained during ground runs of the XB-70 airplane enabled the attenuation of sound to be determined for ground-to-ground propagation over distances of 500 feet (152 meters) and 1000 feet (305 meters) for one set of atmospheric conditions. The considerable scatter in the experimentally determined attenuations seemed to be associated with variations in the wind parameters. For downwind propagation, reducing the predicted acoustic-attenuation values ARP 866 by 50 percent for octave bands above 1000 hertz resulted in good agreement between the present experimentally determined and predicted values. Author

N71-17963# American Airlines, Inc., New York. ATC Research Dept.

ATC STOL TASK FORCE

May 1970 21 p
Avail: NTIS

The feasibility of STOL operations in the Northeast Corridor is reviewed, including the viability of a proposed intercity STOL operation in areas heavily congested with air traffic. Area navigation routes and the corresponding en route and terminal area operational procedures are proposed for a STOL operation between Boston Logan Airport, a Manhattan STOLport and Anacostia Naval Air Station. Author

N71-18103# National Aviation Trades Association, Inc., Washington, D.C.

TESTIMONY OF MIDAIR COLLISION HAZARD BEFORE THE NATIONAL TRANSPORTATION SAFETY BOARD

Frank Kingston Smith Nov. 1969 182 p refs
Avail: NTIS

An analysis of midair collisions between commercial aircraft and general aviation aircraft is presented. The causes of midair collisions occurring during 1969 are discussed. Recommendations are made for measures to be employed for reducing the midair collision hazards. P.N.F.

N71-18104# American Airlines, Inc., New York.

INTER-METROPOLITAN STOL EVALUATION (PHASE 10) Final Report

Jan. 1970 146 p
(Rept-50) Avail: NTIS

An integrated inter-metropolitan transport system was investigated to serve the expanding short-haul market. The McDonnell Douglas Model 188 STOL aircraft (Breguet 941S) was selected for the evaulation of the navigation systems, ATC procedures, and operational procedures. It was concluded that effective airline use of STOL aircraft is now operationally and technically feasible. It is recommended that the air carriers develop a STOL transport system, starting with existing aircraft and simple interim facilities, to demonstrate the market and economics of a continuing passenger carrying service. F.O.S.

N71-18114# Stanford Research Inst., Menlo Park, Calif.

TESTS OF ORTHO-DECOUPLED AIRCRAFT STATIC DISCHARGERS

R. L. Tanner and J. E. Nanevicz [1970] 18 p refs
Contracts AF 33(616)-6561; AF 19(604)-3458)
Avail: NTIS

Flight tests were conducted to evaluate devices for discharging static electricity from aircraft without the production of radio interference. The devices employed a principle, known as ortho-decoupling, by which the radio interference generated from corona discharges taking place at the devices is decoupled from the radio antennas. Two different installations of dischargers were tested. In one installation the ortho-decoupling principle was incorporated in flush-mounted dischargers installed along the trailing edges at the tips of wing and tail surfaces. The flush-mounted dischargers were supplemented by small external blade dischargers, also incorporating the ortho-decoupling principle, which were installed in the region of vortex formation at the tips of the airfoil surfaces. In the second installation a number of simple externally mounted rod dischargers replaced the flush-mounted dischargers on the trailing edges. Author

N71-18115# Institute of Transport Aviation, Paris (France).

REGIONAL STATISTICS ON SAFETY IN AIR TRANSPORT [STATISTIQUES REGIONALES SUR LA SECURITE DU TRANSPORT HERIEN]

R. Mathieu 1970 69 p refs
(Rept-1970/10-E) Avail: NTIS

Accidents incurred by scheduled airlines are examined by country or region of the operator. A comparison between the share of each region in scheduled traffic and its share in accidents shows differences in the safety levels of the operators of each region. All accidents occurring in air transport to aircraft of over 5700 kg are considered. Because of lack of data on the corresponding traffic, the accident rates between the operators in the various regions are not made. The proportion of fatal accidents is shown to be higher in air transport accidents as a whole than in scheduled service accidents as a whole. Accidents are also studied by region and type of accident, and differences are noted in the proportion of the same type of accident in total accidents for each region. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N71-17195# Varta Aktiengesellschaft Forschungs- und Entwicklungszentrum, Kelkheim (West Germany).

WORKING ON RANEY NICKEL CATALYSTS [ARBEITEN AN RANEYNICKEL-KATALYSATOREN]

A. Basch and A. Winsel *In* DGLR Proc. of the 9th Meeting of the WGLR on Rocket Technol. Dec. 1969 p 45-48 In GERMAN (See N71-17192 07-27)
Avail: NTIS; ZLDI Munich: 17 DM

Recent work on Raney nickel catalysts to minimize ammonia formation in hydrazine fuel cells is discussed. ESRO

N71-17248# Communications Satellite Corp., Washington, D.C.

FOREIGN SOLAR CELL SYMPOSIUM Summary Report

Denis J. Curtin [1969] 49 p Conf. held at Washington, D.C., 22 Sept. 1969; sponsored by Commun. Satellite Corp.
Avail: NTIS

The proceedings of a conference on the manufacture of silicon solar cells are presented. Topics discussed are a description of foreign solar cell manufacturing processes, manufacturing facilities, cell efficiencies, cell prices, types of cell contacts, radiation resistance of solar cells, and solar cell interconnects. Thin film solar cells, including cadmium sulfide and cadmium telluride solar cells, are discussed. An evaluation of the present status of the thin film cell work in Europe to determine when the cell might be fully developed is reported. Author

N71-17262*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRICAL PERFORMANCE OF THREE SOLAR THERMOELECTRIC TEST SECTIONS
William J. Bifano, Erich W. Kroeger, and Robert B. Ruch Washington Feb. 1971 24 p
(NASA-TM-X-2175; E-5925) Avail: NTIS CSCL 10B

Current-voltage characteristics were measured for three planar test sections of a solar thermoelectric generator designed to operate at 0.25 AU from the sun. Each test section consisted of nine silicon-germanium thermocouples mechanically attached to a beryllium radiator plate. Measurements were made at average hot junction temperatures in the range of 640 deg to 940 C. All three test sections produced the design power output of 2.8 watts at 1.0 volt; however, junction temperatures approximately 50 C higher than predicted were required to achieve this power because of poor thermal contact between the thermocouple stud and the radiator plate. One of the tests sections, life-tested for 3000 hours, exhibited an increase in internal resistance of about 14 percent, corresponding to a decrease in power output of about 6 percent. Author

N71-17269*# Gulton Industries, Inc., Metuchen, N.J. Battery and Power Sources Div.
DEVELOPMENT OF A NON-MAGNETIC, STABLE, CADMIUM ELECTRODE FOR SILVER-CADMIUM CELLS Final Report
S. Larner and S. Charlip 31 Jan. 1971 142 p
(Contract NAS3-11829)
(NASA-CR-72805) Avail: NTIS CSCL 10C

Several fabricating techniques were used including pasting, pressing, and impregnating cadmium salts into sintered silver plaques. The raw materials under investigation were commercial cadmium oxide and Gulton produced cadmium hydroxide. The electrode combination which gave the best results was a compound of teflon and cadmium hydroxide which had been heat cured and pressed onto a silver screen. Initial utilization of these electrides, on early cycles, yielded better than 80% of theoretical capacity. This utilization stabilized to approximately 65% on continued cycling. This value compares with less than 40% for cadmium electrodes presently in use in the silver-cadmium system. Silver-cadmium cells, of 5 Ah capacity, were fabricated from the teflonated cadmium hydroxide electrodes and placed on a cycling regime of 24 hour orbit (22.8 hour charge and 1.2 hour discharge) at 50% depth of discharge. Ten cells have completed an average of 382 cycles (five at 342 and five at 382). Author

N71-17370*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOTORING CHARACTERISTICS OF A 2- TO 10-KILOWATT BRAYTON ROTATING UNIT
Robert C. Evans, Sheldon J. Meyer, and Robert Y. Wong Washington Feb. 1971 24 p refs
(NASA-TM-X-2154; E-5940) Avail: NTIS CSCL 10B

Motoring tests were performed on a single-shaft turbine-compressor-alternator designed for use in a 2- to 10-kilowatt space-power system. This report presents the results obtained in terms of starting current, torque, and acceleration time for a range of supply frequencies from 212 to 1200 hertz and a range of voltage-to-frequency ratios from 0.04 to 0.1. Author

N71-17371*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULATED SPACE ENVIRONMENT TEST OF A 25-CELL CADMIUM SULFIDE THIN-FILM SOLAR-CELL MODULE
Anthony F. Ratajczak and Thomas M. Klucher Washington Feb. 1971 15 p refs
(NASA-TM-X-2125; E-5942) Avail: NTIS CSCL 10A

A 25-cell cadmium sulfide thin-film solar-cell module was tested in a simulated space environment for almost 2000 hours to determine the integrity of its mechanical and electrical connections and learn something of module electrical characteristics. During the test, the module was mechanically and electrically loaded to simulate spacecraft applications. There was no detectable evidence of degradation in the cell-to-cell connections. Maximum power output, fill factor, short-circuit current, and open-circuit voltage degraded in a manner characteristic of cadmium sulfide solar cells. Author

N71-17467*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE GAS PHASE IN POROUS FUEL-CELL ELECTRODES
Robert W. Easter Washington Feb. 1971 44 p refs
(NASA-TN-D-6168; E-5754) Avail: NTIS CSCL 10A

A generalized physical model of a porous fuel-cell electrode is described, and the basic equations pertaining to the gas phase therein are presented. The equations are solved for various postulated spatial distributions of current production in the electrode. Three dimensionless parameters are defined, the numerical values of which yield information about the concentration gradients in the gas phase within the electrode for both pure reactant gases and reactant gases containing an inert impurity. Author

N71-17470*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION REPORT FOR SECONDARY SPACECRAFT CELLS: CYCLE LIFE TEST Annual Report
D. E. Christy and J. D. Harkness 29 Jan. 1971 290 p
(NASA Order W-12397)
(NASA-CR-116509; QE/C-71-1; AR-7) Avail: NTIS CSCL 10A

Evaluation of secondary spacecraft cells in life cycle tests produced the following information on cell performance characteristics and limitations: (1) nickel-cadmium cells tested at 0 C give longer cycle life, higher end-of-discharge voltages and less degradation of ampere-hour capacities than cells tested at 25 C and 40 C. Overall performance decreases with increase in depth of discharge at all test temperatures; (2) cycle life data are more limited on silver-cadmium cells; (3) the silver-zinc packs were predominantly 24-hour orbit, 40 percent depth of discharge at 25 C; silver-zinc has a very short life under conditions ranging from 32 to 325 days of cycling, with the average being 120 days; and (4) cell failure analyses have shown several failure modes such as little or no insulation around tabs and busses, ceramic shorts across the terminals, and leaks around the terminals. Author

N71-17471*# TRW Systems Group, Redondo Beach, Calif.
MODULAR ENERGY STORAGE AND CONDITIONING (MESAC) STUDY Final Report

Jul. 1970 130 p
(Contract NAS5-9178)
(NASA-CR-116510) Avail: NTIS CSCL 10A

The concept of a centrally controlled modular energy storage and conditioning system for improved reliability of power systems containing batteries was studied. Estimated weight, efficiency, and reliability were analyzed and compared with conventional systems and a breadboard phase containing typical parallel energy storage units. Results established that high efficiency direct energy transfer from source to load without loss elements and at regulated voltages is feasible. A modification of the drive circuitry is necessary to increase boost ratios. The breadboard performed all required functions and continued to operate at rated power levels after simulated failure of one of the energy storage units. G.G.

N71-17568*# Grumman Aerospace Corp., Bethpage, N.Y.
EVALUATION OF NEW APPROACHES TO PACKAGING OF POWER ASSEMBLIES FOR SPACE USE Final Report of Phase 1 Study Phase
Dec. 1970 121 p refs
(Contract NAS9-10411)
(NASA-CR-114854) Avail: NTIS CSCL 10B

An eleven-month study program is described to develop approaches for packaging space electrical power assemblies. The packaging technique includes onboard maintenance features which do not compromise environmental integrity. Author

N71-17581*# General Electric Co., Philadelphia, Pa.
BRAYTON CYCLE VAPOR CHAMBER (HEAT PIPE) RADIATOR STUDY
E. E. Gerrels and J. W. Larson Washington NASA Feb. 1971 279 p refs
(Contract NAS3-10615)
(NASA-CR-1677; GESP-7030) Avail: NTIS CSCL 20M

The vapor chamber (heat pipe) radiator is defined and evaluated as a potential candidate for rejecting waste heat from a Radioisotope Brayton Cycle space power system. A comparison is made with an operationally equivalent condition fin radiator. Both radiators employed DC-200 heat transfer fluid within the primary ducts and aluminum as the basic structural material. Vapor chamber fluids are evaluated and selected for thermal performance and containment within the radiator. Vapor chamber compatibility and performance tests are made for a number of candidate fluids. Preliminary designs are developed for both conduction fin and vapor chamber radiator concepts. A comparison shows no significant advantages attributable to the Brayton cycle vapor chamber radiator where reliability and meteoroid criteria specify 0.99 to 0.999 probability of survival over a five-year lifetime. Author

N71-17675 Texas Technological Coll., Lubbock.
A MODEL FOR ANALYZING THE EXPERIMENTAL VOLTAGE-CURRENT CHARACTERISTICS OF A HYDROGEN-OXYGEN FUEL CELL BATTERY
Clift Moore Epps (Ph.D. Thesis) 1969 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-1469

A steady state model is developed for the voltage output of a hydrogen-oxygen fuel cell battery as a function of battery temperature, reactant pressure, electrolyte concentration, and average cell current. The model includes the effects of activation and concentration polarization in the porous electrodes and resistance polarization in the bulk electrolyte. The results of the mathematical model are fitted to experimental voltage-current data for a hydrogen-oxygen fuel cell battery and shown to be adequate for correlation and extrapolation of these data. Results of the model-fit of the experimental data indicate that for battery currents less than one ampere activation polarization is confined to the oxygen electrode. The hydrogen electrode for these conditions operates near its equilibrium open-circuit potential. At higher battery currents, both electrodes experience mass-transport polarization. An electrolyte penetration mechanism is offered as an additional factor causing polarization at low electrolyte concentrations and low reactant gas pressure. Dissert. Abstr.

N71-17703*# North American Rockwell Corp., Canoga Park, Calif. Atomics International Div.
VOLTAMMETRIC SCREENING OF ELECTRODES IN FUSED SALT ELECTROLYTES
Leo E. Topol, William A. McCollum, Jr., and Samuel J. Yosim 31 Dec. 1970 262 p refs
(Contract NAS3-12970)
(NASA-CR-72791; AI-70-46) Avail: NTIS CSCL 10A

Conductivity, freezing point and voltammetric measurements were made on three melts, ZnCl2(60%)-NaCl(20%)-KCl(20%), AlCl3(61%)-NaCl(39%), and NaOH(50%)-KOH(50%), containing various catholytes and anolytes. All of the metals and salts employed were of very high purity, which necessitated the synthesis of many of the salts. The measured exchange current densities and voltages, as well as the calculated energy densities for the halide systems were compared. From this comparison the best couples for battery feasibility were selected. Since none of the catholytes were soluble in the anhydrous hydroxide melts and since only one anode did not passivate, very few data could be obtained for the NaOH-KOH systems. Author

N71-17785# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DEGRADATION OF CdS THIN FILM SOLAR CELLS IN DIFFERENT ENVIRONMENTS
Alan G. Stanley 6 Nov. 1970 25 p refs
(Contract F19628-70-C-0230)
(AD-715285; TN-1970-33; ESD-TR-70-341) Avail: NTIS CSCL 10/2

Cadmium sulfide thin film cells were operated under different bias conditions for periods of six months in the following environments: vacuum thermal cycling between −160 and 60C, constant illumination in vacuum and in dry oxygen at 60C. The results were compared to the degradation of test cells in synchronous orbit. It was concluded from the observed changes in the I-V characteristics that the degradation is caused primarily by a combination of light and temperature and not by purely thermal stresses. The presence of a vacuum does not appear to be a significant contributory factor to the ultimate degradation of the cells. Author (GRA)

N71-17864*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOTOR-STARTING CHARACTERISTICS OF MODIFIED LUNDELL ALTERNATOR
David S. Repas and Robert J. Frye Washington Mar. 1971 13 p refs
(NASA-TM-X-220; E-5988) Avail: NTIS CSCL 10B

A modified Lundell, or Rice, alternator designed for use in a single shaft, Brayton cycle space-power system was started as an induction motor. Armature current, rotational speed, and field voltage were measured. Torque was computed from its relation to measured accelaration and moment of inertia. Author

N71-17865*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACTUATOR DESIGN FOR THE SERT 2 BEAM PROBE
Charles E. Provencher, Jr., David D. Renz, and Evert B. Hurst

Washington Mar. 1971 33 p ref
(NASA-TM-X-2190; E-5957) Avail: NTIS CSCL 22B

The description of the mechanical and electrical design of an actuating device for the SERT 2 spacecraft is presented. Details of the structural design, lubrication techniques, electrical circuitry, and testing program are given. During vacuum tank testing, one assembly performed 1185 cycles of operation. Two actuators were launched with the SERT 2 spacecraft on February 3, 1970. One unit accomplished 53 successful operations by June 10, 1970, and then failed during the 54th operation. The second unit accumulated 20 actuations by August 31, 1970, of which 12 were with an operating thruster. Four more were accomplished by October 22, 1970, without an operating thruster. The actuator was performing satisfactorily at that time. Author

N71-17883*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADSORPTION OF CADMIUM IONS ON A PLATINUM ELECTRODE
Sol Gilman and Lawrence D. Sangermano Washington Mar. 1971 17 p refs
(NASA-TM-X-2198; E-5971) Avail: NTIS CSCL 10A

Life of an experimental cadmium-oxygen battery cell is limited by degradation of the platinum-oxygen electrode; dissolved cadmium causes an increase in the overvoltage for oxygen electroreduction at a smooth platinum electrode in 1 N KOH. Using linear sweep voltammetry, evidence was found that cadmium ions absorb in a valence state lower than +2. The adsorption becomes appreciable just below the reversible oxygen potential (1.23 V with respect to the reversible hydrogen electrode in the same electrolyte), varies from 0.2 to 0.25 of a monolayer at potentials from 0.7 to 0.1 V, and then rises steeply as the potential is lowered further. The observed cadmium adsorption isotherm is consistent with observed catastrophic failure of a practical oxygen electrode operating at constant current in the presence of cadmium ions. Author

N71-17884# Aerospace Corp., El Segundo, Calif. Lab. Operations.
LOW-ENERGY PROTON DAMAGE TO SILICON SOLAR CELLS Technical Report, Jan. 1969–Jan. 1970
Edwin J. Stofel and David E. Joslin 15 Oct. 1970 40 p refs
(Contract F04701-70-C-0059)
(AD-715261; TR-0059(6250-20)-8; SAMSO-TR-70-407) Avail: NTIS CSCL 10/2

The effect of low-energy (<2 MeV) proton irradiation upon the junction properties of silicon solar cells has been measured. These measurements are used to explain the large power loss observed on the ATS-1 and Intelsat II-4 satellites. Author (GRA)

N71-18126# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
MATERIALS AND STRUCTURES USED FOR NOZZLES IN MAGNETOHYDRODYNAMIC CONVERSION OF THERMAL ENERGY OF BURNING GASES TO ELECTRICAL ENERGY
David Yerouchalmi (Ph.D. Thesis–Paris Univ., Orsay) Oct. 1970 141 p refs In FRENCH
(CEA-R-4062) Avail: AEC Depository Libraries

Direct power conversion by magnetohydrodynamics of thermal energy into electrical energy is defined by the appropriate hot-gas thermodynamic cycles. Only a nozzle-type generator operating in an open cycle was considered. The operating conditions to which both the conducting and insulating walls of the nozzle were initially subjected changed in an unpredictable manner as the cycle became established. An intermediate temperature (2000 C) between the hot and cold walls was achieved by regulating the wall temperatures. Various additional phenomena such as: solid-state electrolysis, vaporization, and corrosion by alkali seed migration were studied. The electrodes ZrO2/rare earths and ZrO2/rare earths + lanthanum chromites were studied in particular. Mechanical cooling devices, cold electric junctions, and current relays were investigated. NSA

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N71-16905# Advisory Group for Aerospace Research and Development, Paris (France).
REST AND ACTIVITY CYCLES FOR THE MAINTENANCE OF EFFICIENCY OF PERSONNEL CONCERNED WITH MILITARY FLIGHT OPERATIONS
Nov. 1970 110 p refs Presented at the AGARD Aerospace Med. Panel Specialist Meeting, Oslo, 13–14 May 1970
(AGARD-CP-74-70 Avail: NTIS

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3. SLEEP AT UNUSUAL HOURS, DRUGS AND SUBSEQUENT PERFORMANCE M. F. Allnutt (Royal Air Force Inst. of Aviation Med.) 8 p refs (See N71-16908 07-04)

4. EVALUATION OF SLEEP, PERFORMANCE AND PHYSIOLOGICAL RESPONSES TO PROLONGED DOUBLE CREW FLIGHTS. C-5 OPERATION COLD SHOULDER: A PRELIMINARY REPORT V. Pegram, W. Storm (Aerospace Med. Div. Aeromedical Res. Lab. (6571st), B. O. Hartman, D. A. Harris, and H. B. Hale (School of Aerospace Med.) 16 p refs (See N70-16909 07-05)

5. A SUBJECTIVE ASSESSMENT OF FATIGUE IN TRANSPORT AIRCREW L. G. Innes (Canadian Armed Forces Inst. of Environ. Med.) 9 p refs (See N70-16910 07-04)

6. SIMULATED TIME-ZONE SHIFTS AND PERFORMANCE ABILITY: BEHAVIORAL, ELECTROENCEPHALOGRAPHIC AND ENDOCRINE EFFECTS OF TRANSIENT ALTERATIONS IN ENVIRONMENTAL PHASE J. Berkhout (Calif. Univ., Los Angeles) 11 p refs (See N70-16911 07-04)

7. INFLUENCE OF DUTY HOURS ON SLEEP PATTERNS IN AIRCREW OPERATING IN THE LONG HAUL TRANSPORT ROLE. A STUDY OF SINGLE CREW OPERATIONS AND DOUBLE CREW CONTINUOUS FLYING OPERATIONS A. N. Nicholson (Royal Air Force Inst. of Aviation Med.) 11 p refs (See N71-16912 07-04)

8. DIFFERENCES BETWEEN MILITARY AND COMMERCIAL AIRCREWS REST AND ACTIVITY CYCLES K. Staack (Air Transport Command) 6 p (See N71-16913 07-04)

9. WORKLOAD AND PERFORMANCE LIMITING FACTORS OF AIR TRAFFIC CONTROL RADAR OPERATORS H. J. Zetzmann (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, W. Ger.) 14 p refs (See N70-16914 07-04)

10. WORK-REST CYCLES IN AIR TRAFFIC CONTROL TASKS V. D. Hopkin (Royal Air Force Inst. of Aviation Med.) 11 p refs (See N71-16915 07-04)

11. TECHNICAL EVALUATION A. J. Benson (Royal Air Force Inst. of Aviation Med.) 5 p (See N71-16916 07-04)

N71-16906# Max-Planck-Institut fur Verhaltensphysiologie, Seewiesen uber Starnberg (West Germany).
CIRCADIAN RHYTHMS OF SOME PSYCHOLOGICAL FUNCTIONS UNDER DIFFERENT CONDITIONS
R. Wever *In* AGARD Rest and Activity Cycles for the Maintenance

of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 11 p refs (See N71-16905 07-04)
Avail: NTIS

Just as nearly all physiological functions, most measurable psychological functions show clear circadian rhythms. Their measurement requires, in contrast to that of physiological functions like rectal temperature, the wakefulness of the subjects. Therefore, measurements during night time can only be obtained, either when the subjects become awakened several times from sleep, or when they are continuously awake. In the first case, there are clear circadian rhythms, for instance in reaction time, with high performance during day time and low performance during night time. In the second case, the circadian amplitude of several functions decreases, coming from an approximation of the night values to the day values. This means: performance during night time is higher when subjects are continuously awake than when they are awakened from sleep at the same time, and this difference seems to be the greater the more performance depends on decisions. This may be of interest with regard to alert readiness. Author

N71-16907# Max-Planck-Institut fur Arbeitsphysiologie, Dortmund (West Germany).
INVESTIGATIONS CONCERNING REACTION TIME IN RELATION TO DURATION OF SLEEP AND TIME OF DAY
J. Rutenfranz, J. Aschoff, and H. Mann *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 5 p refs (See N71-16905 07-04)
Avail: NTIS

The maintenance of the efficiency of personnel who have to work shift duties depends upon an alteration of their circadian rhythm to match the new work and rest cycles or at least some form of adaptation to the duty at unfamiliar hours. The temporal transposition of an individual's circadian rhythm to coincide with work and rest at unusual times of day is limited because it is very difficult to alter the prime synchronizers of the rhythm, such as knowledge of time of day and social contacts. When a stabilized shift system is operated, the circadian rhythm may come into phase with the duty period after two or more weeks, but with a rotating shift system such an alteration in the phase of the rhythm cannot be expected to occur. Author

N71-16908# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
SLEEP AT UNUSUAL HOURS, DRUGS AND SUBSEQUENT PERFORMANCE
M. F. Allnutt *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 8 p refs (See N71-16905 07-04)
Avail: NTIS

A recent experiment in which eight trainee pilots were sent to bed at 20 00 hours, and then woken up at 03 00 hours to spend the rest of the day carrying out tests of performance is reported. There were four experimental conditions (no drug, placebo, mogadon, and seconal), each subject spending two nights under each condition. During every alternate 24 hour period of the three weeks for which the experiment lasted, the subjects were off duty and free to sleep as they pleased. In addition to objective measures of performance and subjective measures of mood and sleep, continuous EEG recordings were made throughout each experimental night. Author

N71-16910# Canadian Armed Forces Inst. of Environmental Medicine, Toronto (Ontario).
A SUBJECTIVE ASSESSMENT OF FATIGUE IN TRANSPORT AIRCREW
L. G. Innes *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 9 p refs
Avail: NTIS

Two questionnaire studies were carried out on fatigue reactions of transport aircrew on transatlantic flights of approximately 12 hours duration. The first questionnaire assessed exhaustion fatigue due to the flight for all crew positions, and identified crewmembers having unusually high ratings. The second questionnaire study assessed nervous fatigue in the same type of operation, and again two crew positions only were identified as being of concern. There was no relationship between fatigue ratings and sleep patterns, nor with easterly or westerly direction of flight. Analysis of the use of questionnaire items showed that frequency of check marks against fatigue statements did not correspond well with fatigue rating. Author

N71-16911# California Univ., Los Angeles. Space Biology Lab.
SIMULATED TIME-ZONE SHIFTS AND PERFORMANCE ABILITY: BEHAVIORAL, ELECTROENCEPHALOGRAPHIC AND ENDOCRINE EFFECTS OF TRANSIENT ALTERATIONS IN ENVIRONMENTAL PHASE
Jan Berkhout *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 11 p refs (See N71-16905 07-04)
(Contract AF 49(638)-1387)
Avail: NTIS

Three subjects were maintained on an experimental sleepactivity time-line which simulated a flight assignment crossing ten time-zones eastbound and return within 72 hours. The subjects were required to operate an automobile and an array of electronic equipment during the simulated flights. Sleep periods were assigned during the simulated local night, involving a ten hour translation of normal habits, and occasioning two 12 hour epochs of sleep deprivation. Including baseline and recovery periods, the subjects were studied continuously for nine days. Mental calculating ability, motor coordination and auditory perceptual acuity were determined several times per day throughout this period. Electroencephalograms were recorded during all assigned sleep periods and during the administration of behavioral tests. All urine produced during the experiment was collected, and volume, osmolarity, creatinine and 17-OHC levels were determined as a function of time-of-day. Author

N71-16912# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
INFLUENCE OF DUTY HOURS ON SLEEP PATTERNS IN AIRCREW OPERATING IN THE LONG HAUL TRANSPORT ROLE. A STUDY OF SINGLE CREW OPERATIONS AND DOUBLE CREW CONTINUOUS FLYING OPERATIONS
A. N. Nicholson *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 11 p refs (See N71-16905 07-04)
Avail: NTIS

Military aircrew operating in the strategic long haul role experience repeated time zone changes and irregular and often long hours of duty. A satisfactory sleep pattern is of prime importance in maintaining their well-being and operational efficiency. The normal regular nightly period of sleep during non-flying duty at base is replaced by a complex sleep pattern while operating world-wide East-West routes. However, the sleep obtained over three days preceding each duty period is usually similar in duration to that obtained over three day periods while on non-flying duty and the ability of the pilot to obtain a similar amount of sleep appears to be an essential factor in preventing subjective fatigue. There is a cumulative effect of repeated adaptation to time zones and irregular hours of duty. Aircrew find it increasingly difficult to maintain an acceptable sleep pattern as the number of days route flying

increases. It would appear that the work load (average hours duty/day) compatible with an acceptable sleep pattern diminishes in a logarithmic manner with the number of duty days. This implies restrictions to the deployment of aircrew if serious sleep disturbances are to be avoided. Author

N71-16913# Air Transport Command, Trenton (Ontario).
DIFFERENCES BETWEEN MILITARY AND COMMERCIAL AIRCREWS REST AND ACTIVITY CYCLES
Kay Steack *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 6 p (See N71-16905 07-04)
Avail: NTIS

Aircrew members flying the Boeing 707 have been interviewed with respect to their flying duty, ground duty and duty-free time. The results of these interviews show, that the difficulties arising are not so much caused by the duration of flights and even less by the disturbed diurnal rhythm, but very much more by certain administrative procedures, by prolonged layover times and, most of all, by the ground duty times. In this respect, there is a marked difference between military aircrews and aircrews of commercial airlines. Good leadership and team spirit as well as an effective organization are of great importance. Author

N71-16914# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
WORKLOAD AND PERFORMANCE LIMITING FACTORS OF AIR TRAFFIC CONTROL RADAR OPERATORS
Hans J. Zetzmann *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 14 p refs (See N71-16905 07-04)
Avail: NTIS

In the servo loops of the man-machine system of air traffic control man continues to play a decisive role in ensuring safe and expeditious running of traffic. An important source of information in this system is the radar equipment whose display gives the controller an important basis for evaluating the air situation. These displays are discussed from the aspect of human engineering. Where traffic is dense, particularly high demands are placed on correctness and rapidity of controller decisions to ensure a safe dispatch of traffic. The physiological environment of ATC activities and how readily human beings may here be subject to stress are reported. The definitions of the terms workload and stress are discussed; it is shown that, and why, all efforts towards an exact assessment of controller capability under peak loads have failed to lead to fully satisfactory results so far. Author

N71-16915# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
WORK-REST CYCLES IN AIR TRAFFIC CONTROL TASKS
V. D. Hopkin *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 11 p refs (See N71-16905 07-04)
Avail: NTIS

There is no established practice or international agreement on the total weekly hours worked in air traffic control tasks, or on the optimum lengths of watches or shifts. Tasks range from those with a high vigilance component, where efficiency is associated with short work periods and frequent brief rests, to those requiring long hand-over periods, where unacceptable double-manning would occur if the work periods were short. Continuous eight hour shifts, with meals at the working position, are not unknown; these shifts may include high workload, though not all the time. The air traffic controller has little influence on his own workload. Traditionally, his colleagues expect him to deal with whatever traffic enters his sector. He does so, at the cost of hard and sustained effort when workload is high, which sometimes results in extreme tiredness which may prevent him from relaxing after the end of his shift. The effects of work-rest cycles on performance have been the subject of much discussion in air traffic control circles, but of relatively little scientific work. What has been done is reported; what could be done is suggested. Author

N71-16916# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
TECHNICAL EVALUATION
A. J. Benson *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 5 p (See N71-16905 07-04)
Avail: NTIS

The text, discussion and technical evaluation of ten papers presented at the AGARD Aerospace Medical Panel's Specialist Meeting which was held in Oslo, Norway on 13 and 14 May 1970 are presented. The meeting was convened in response to a request from the Military Committee of NATO for advice on the influence of work and rest schedules on the operational efficiency of personnel concerned with flight operations. The papers presented fell into three main categories: a) laboratory investigations of normal and abnormal work/rest schedules, b) in-flight studies of aircrew operating long-haul transports, c) duty cycles in air traffic control tasks. Author

N71-16980# Joint Publications Research Service, Washington, D.C.
MODIFICATION OF RATE OF VESTIBULAR COMPENSATORY PROCESS IN RELATION TO POSITION OF HEAD IN SPACE
A. A. Shipov et al *In its* The Operation of the Vestibular Analyzer 14 Jan. 1971 p 24–33 refs (See N71-16978 07-05)
Avail: NTIS

The role of the position of the head in space on the course of the compensatory process was investigated using as a model a unilaterally labyrinthectomized rabbit. It was shown that the rate of the compensatory process in animals is slowed down when the position of their head was forcibly kept on a horizontal plane. This fact is explained by the characteristic redistribution of proprioceptive impulsation of the neck muscles reaching vestibular nuclei. Author

N71-17082# Hawaii Univ., Honolulu. Dept. of Physiology.
EFFECT OF IMMERSION AT DIFFERENT WATER TEMPERATURES ON GRADED EXERCISE PERFORMANCE IN MAN
T. O. Moore, E. M. Bernauer, G. Seto, Y. S. Park, and S. K. Hong Aug. 1970 31 p refs
(Grant NSF GH-62)
(PB-194822; SEAGRANT-70-3; UHI-med-70-03) Avail: NTIS CSCL 06S

Eight subjects performed graded leg exercise at loads from light to forced maximal in air and totally submerged in water at 30, 22, and 16 C. There was no significant decrement in performance between the air and immersed environments. Heart rate, minute volume (VE), oxygen consumption (VO2), and carbon dioxide production had high linear correlation coefficients with imposed work load. Oxygen consumption and carbon dioxide production were higher in water under all work loads and at the two lower water temperatures. Heart rate was the same at rest under all conditions, but significantly less at high work loads in 16 C water when compared to air. It is concluded that monitoring of a diver's heart rate will cause underestimation of work load in surface-equivalent terms at high loads in water of low temperature. Author (GRA)

N71-17066# Joint Publications Research Service, Washington, D.C.
ALTITUDE AND HEAT ADAPTATION STUDIES
19 Jan. 1971 24 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 56, no. 9, 1970 p 1208–1214 and 1282–1287
(JPRS-52200) Avail: NTIS

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1. PHYSIOLOGICAL INDICES OF STATE OF BRAIN AND MUSCLE DURING HIGH-ALTITUDE ACCLIMATION A. A. Aydaraliyev et al p 1–12 refs (See N71-17067 07-04)
2. EFFECT OF MUSCULAR TRAINING ON MAN'S ENDURANCE OF HEAT F. T. Agarkov et al (See N71-17068 07-04)

N71-17067# Joint Publications Research Service, Washington, D.C.
PHYSIOLOGICAL INDICES OF STATE OF BRAIN AND MUSCLE DURING HIGH-ALTITUDE ACCLIMATION
A. A. Aydaraliyev et al *In its* Altitude and Heat Adaptation Studies 19 Jan. 1971 p 1–12 refs (See N71-17066 07-04)
Avail: NTIS

Results are presented of studies carried out on the changes in tissue oxygen tension (pO2), redox potential (Eh), tissue blood flow (Bf), and temperature (T) of the brain cortex and gastrocnemius muscle during adaptation to high mountainous altitudes. The investigation results demonstrate that a 60-day stay in the mountains is accompanied by changes in the physiological indices of the brain cortex and skeletal muscles. It is noted that in the brain cortex the redox potential, tissue blood flow, and temperature increase, while tissue oxygen tension decreases, indicating intensification of the oxidation processes. This intensification continues up to the 15th day, after which the physiological indices gradually return to normal. In the gastrocnemius muscle, a reverse pattern is observed: a decrease of T, Eh, Bf, and pO2. The maximum decrease occurs by the 15th day, after which the physiological indices of the gastrocnemius muscle return to their initial level. Author

N71-17068# Joint Publications Research Service, Washington, D.C.
EFFECT OF MUSCULAR TRAINING ON MAN'S ENDURANCE OF HEAT
F. T. Agarkov et al *In its* Altitude and Heat Adaptation Studies 19 Jan. 1971 p13–23 refs (See N71-17066 07-04)
Avail: NTIS

Studies were made of the effect of physical training achieved through heavy athletics, gymnastics, and boxing, on the endurance of the athletes' organism in relation to intensive extreme-heat action. Such training, while increasing physical endurance and efficiency, also ensures the development of a state of nonspecific higher resistance to heat action. This is due to the improvement of physical and chemical thermoregulation and the formation of adaptive reactions which guarantee the body's improved endurance of disruptions of the homeostatic (temperature) stability of the internal medium. Muscular training, while raising the thermal stability of the human organism, is shown to be less effective than some specific heat training. Author

N71-17097# Hawaii Univ., Honolulu. Dept. of Physiology.
ALVEOLAR GAS EXCHANGES AND CARDIOVASCULAR FUNCTIONS DURING BREATH-HOLDING WITH AIR
S. K. Hong, Y. C. Lin, D. A. Lally, B. J. B. Yim, and N. Kominami Aug. 1970 34 p refs
(Grant NSF GH-62)
(PB-194823; SEAGRANT-70-4; UHI-med-70-04) Avail: NTIS CSCL 06S

During 4 min breath-holding (BH) with TLC or 160 see BH with FRC PAO2 decreased continuously, reaching approximately 30 mm Hg at the end, while PACO2 increased during first 30 sec after which it leveled off at approximately 50 mm Hg. During 4 min BH the lung supplied 700 ml of O2 into the blood while it gained only 160 ml of CO2 from the blood, indicating a significant retention of CO2. Both PaO2 and PaCO2 changed during BH in a manner similar to those of alveolar gas. Arterial O2 content decreased by 12.5 vols. % and CO2 content increased by 17.0 vols. % during 4 min BH. Mixed venous O2 pressure and content approached arterial blood values toward the end of BH. Author (GRA)

N71-17098# National Physical Lab., Teddington (England). Aerodynamics Div.
ON THE STABILITY OF AUDITORY THRESHOLD
M. E. Delany Jul. 1970 31 p refs
(NPL-AERO-Ac-44) Copyright. Avail: NTIS

Using experienced subjects it is shown that the total replication variance for threshold tests repeated within a period of 27 months was of order 3 sq db at 1 kHz, rising to 15 sq db at 80 Hz and to 30 sq db at 12 kHz. The component due to true long-term changes was of order 1 to 2 sq db. Even with experienced subjects the mean hearing level on any given day improved by about 1 db on second and subsequent tests, while inexperienced subjects showed additional improvements due to familiarization varying from 1 to 9 db. Author (ESRO)

N71-17146# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.
ON THE ALTERATION OF PSYCHOMOTOR PERFORMANCE DURING ACUTE ALTITUDE EXPOSURE OF SEVERAL HOURS' DURATION BETWEEN 2000 AND 4000 m [UEBER DIE VERAENDERUNG DER PSYCHOMOTORISCHEN LEISTUNGSFAEHIGKEIT WAEHREND MEHRSTUENDIGER AKUTER HOEHENEXPOSITION AUF 2000 BIS 4000 m]
Christa Rehme (Ph.D. Thesis–Bonn Univ.) Sep. 1970 53 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-37) Avail: NTIS; ZLDI Munich: 15,10 DM

The effects of pressure reductions on the psychomotor performances of 12 students was studied for 5 hours in a low pressure chamber. Performance was measured by pellet recorders, optical reaction times, and memory tests. The reaction times and the complex psychomotor performances deteriorated with long exposure time. The times for the appearances of the first significant changes as functions of altitude are discussed. Author (ESRO)

N71-17237# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Meckenheim (West Germany).
PROCEEDINGS OF THE EIGHTH WGLR MEETING ON HUMAN FACTORS ENGINEERING [BERICHT UEBER DIE 8. SITZUNG DES WGLR-FACHAUSSCHUSSES FUER ANTHROPOTECHNIK]
Apr. 1970 103 p refs In GERMAN; ENGLISH summary Conf. held at Munich, 28 Nov. 1969
(DLR-Mitt-70-11) Avail: NTIS; ZLDI Munich: 21,20 DM

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1. HUMAN REACTIONS TO MECHANICAL VIBRATIONS H. Dupuis (Max-Planck-Inst. fuer Landarbeit und Landtechnik) p 7–14 refs (See N71-17238 07-04)
2. METHODOLOGICAL STUDIES FOR THE APPLICATION OF SECONDARY TASKS FOR MEASURING THE PSYCHOLOGICAL WORK LOAD S. Fichtbauer (DFVLR, Hamburg) p 15–55 refs (See N71-17239 07-04)
3. METHODS FOR MEASURING THE PSYCHOLOGICAL STRESS DURING PILOT PERFORMANCE G. W. Radl

(Forschungsinst. fuer Anthropotechnik) p 57–93 refs (See N71-17240 07-04)

4. PSYCHOLOGICAL STRESS AND BIOSENSORS L Vogt (DFVLR, Bad Godesberg) p 95–101 (See N71-17241 07-04)

N71-17238# Max-Planck-Institut fuer Landarbeit und Landtechnik, Bad Kreuznach (West Germany).

HUMAN REACTIONS TO MECHANICAL VIBRATIONS [UEBER DIE BEANSPRUCHUNG DES MENSCHEN DURCH MECHANISCHE SCHWINGUNGEN]

H. Dupuis *In* DGLR Proc. of the 8th WGLR Meeting on Human Factors Eng. Apr. 1970 p 7–14 refs In GERMAN N71-17237 07-04)

Avail: NTIS; ZLDI Munich: 21.20 DM

Recent research in the field of human reactions to mechanical vibrations, especially for drivers of transport vehicles, is reviewed. ESRO

N71-17239# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg (West Germany). Inst. fuer Flugmedizin.

METHODOLOGICAL STUDIES FOR THE APPLICATION OF SECONDARY TASKS FOR MEASURING THE PSYCHOLOGICAL WORK LOAD [METHODENFRAGEN ZUR ANWENDUNG VON NEBENAUFGABEN ZUR MESSUNG DER PSYCHISCHEN ARBEITSBEANSPRUCHUNG]

S. Fichtbauer *In* DGLR Proc. of the 8th WGLR Meeting on Human Factors Eng. Apr. 1970 p 15–55 refs In GERMAN (See N71-17237 07-04)

Avail: NTIS; ZLDI Munich: 21.20 DM

The method, single and multiple channel theories of the central human information processor, and other fundamental problems are described. The practical application of the method, mainly in connection with pilot problems, is discussed. ESRO

N71-17240# Forschungsinstitut fuer Anthropotechnik, Meckenheim (West Germany).

METHODS FOR MEASURING THE PSYCHOLOGICAL STRESS DURING PILOT PERFORMANCE [METHODEN ZUR MESSUNG DER PSYCHISCHEN BEANSPRUCHUNG BEI FLUGFUEHRUNGSAUFGABEN]

G. W. Radl *In* DGLR Proc. of the 8th WGLR Meeting on Human Factors Eng. Apr. 1970 p 57–93 refs In GERMAN (See N71-17237 07-04)

Avail: NTIS; ZLDI Munich: 21.20 DM

After discussion of the psychological stress concept, methods of measuring it are reviewed. Particular attention is given to pilot performance. ESRO

N71-17241# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany) Inst. fuer Flugmedizin.

PSYCHOLOGICAL STRESS AND BIOSENSORS [PSYCHISCHE BEANSPRUCHUNG UND BIOSENSOREN]

L. Vogt *In* DGLR Proc. of the 8th WGLR Meeting on Human Factors Eng. Apr. 1970 p 95–101 In GERMAN (See N71-17237 07-04)

Avail: NTIS; ZLDI Munich: 21.20 DM

Methods for indicating changes in the human body under stress circumstances are described. The best methods should correlate with psychological stress, not vary randomly, and disturb the test person as little as possible. ESRO

N71-17255# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.

EFFECTIVE APPROACHES TO DISORIENTATION FAMILIARIZATION FOR AVIATION PERSONNEL

William E. Collins Nov. 1970 22 p refs

(FAA-AM-70-17) Avail: NTIS

Techniques are discussed for providing familiarization of aviation personnel with disorientation problems. The procedures are spelled out in detail. Methods of modifying existing equipment as well as an evaluation of available commercial equipment are presented. The techniques have been used with notable success both at the Civil Aeromedical Institute and in the field. They are relatively inexpensive, effective both for participants and observers, and are readily accepted by flyers as pertinent to the aviation situation. Author

N71-17429# Joint Publications Research Service, Washington, D.C.

THE BIOSPHERE

4 Feb. 1971 23 p refs Transl. into ENGLISH from Priroda (Moscow), no. 8, 1970 p 2–9 and 24–27

(JPRS-52325) Avail: NTIS

CONTENTS:

1. THE BIOSPHERE AND MAN N. V. Timofeyev-Resovskiy p 1–15 refs (See N71-17430 07-04)

2. PROTECTING THE BIOSPHERE FROM TOXIC CHEMICALS S. D. Zaugol'nikov et al p 15–22 refs (See N71-17431 07-04)

N71-17430# Joint Publications Research Service, Washington, D.C.

THE BIOSPHERE AND MAN

N. V. Timofeyev-Resovskiy *In its* The Biosphere 4 Feb. 1971 p 1–15 refs (See N71-17429 07-04)

Avail: NTIS

The relationship between the numerical growth and expanding industrial and technological power of man and the biosphere is discussed. The requirement for greater symbiosis of man with the biosphere is emphasized. R.B.

N71-17431# Joint Publications Research Service, Washington, D.C.

PROTECTING THE BIOSPHERE FROM TOXIC CHEMICALS

S. D. Zaugolnikov et al *In its* The Biosphere 4 Feb. 1971 p 15–22 refs (See N71-17429 07-04)

Avail: NTIS

The hygienic effects of man's activity on nature and on the populations of individual regions and countries, as well as on a global scale, are considered. Recommendations are given for protecting the environment from polution by toxic chemicals. R.B.

N71-17448# Joint Publications Research Service, Washington, D.C.

PERCEPTION OF THE RESPIRATORY MEDIUM AND GAS PREFERENCE IN MAN AND ANIMALS

I. S. Breslav 4 Feb. 1971 68 p ref Transl. into ENGLISH from the book "Vospriyatiye Dykhatel'noy Sredy i Gazopreferendum u Zhivotnykh i Cheloveka" Leningrad, Nauka, 1970 p 23–60, 73–84, 117–120, 132–136

(JPRS-52332) Avail: NTIS

Gas preference reactions to hypoxic, hyperoxic or hypercapnic environments are discussed with respect to the effect of such environments on the vital physiological functions of higher animals and man. Emphasis is given to the most important adaptation responses to altered carbon dioxide and oxygen content in the atmosphere referable to the respiratory and related systems, and the thresholds of such responses; and the effectiveness of such compensatory changes with respect to ability to maintain an adequate gas regimen for the organism and normal vital activity. Author

N71-17449*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, NOVEMBER 1970
Dec. 1970 123 p refs
(NASA-SP-7011(83)) Avail: NTIS CSCL 06B

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N71-17450*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, DECEMBER 1970
Jan. 1971 148 p refs
(NASA-SP-7011(84)) Avail: NTIS CSCL 06B

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N71-17660 Howard Univ., Washington, D.C.
THE EFFECTS OF ALTITUDE AND DRUG ADMINISTRATION ON GLUCOSE TOLERANCE: THE ROLE OF CORTICOTROPIN AT ALTITUDE
Martin Taub (Ph.D. Thesis) 1969 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 70-2001

The fact that ACTH causes a significantly elevated rise in pancreatic and femoral vein insulin within one minute in both intact and adrenalectomized dogs shows that ACTH acts directly on the pancreas to release insulin and that the adrenal glands do not play a role in this action. Since, the increased glucose tolerance seen at altitude could be prevented by drugs (Thorazine and Demerol) which prevent the release of ACTH, it can be concluded that this increased glucose tolerance is due to an ACTH-induced release of insulin from the pancreas. It can also be concluded that exposure to simulated altitude produces a non-specific stress reaction which is independent of the partial pressure of oxygen since ACTH is released under both hypoxic and normoxic conditions. Dissert. Abstr.

N71-17686 Syracuse Univ. N.Y.
A STUDY OF THE MEASUREMENT OF OZONE AND SOME EFFECTS OF OZONE AND NITROGEN OXIDES ON THE ACTIVITY OF RATS
Alvin Stuart Konigsberg (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-1960

A study of the effects of a range of trace concentrations of both ozone produced by high voltage corona discharge in oxygen and ozone produced by high voltage corona discharge in air on the gross motor activity of rats was undertaken. Discharge in air invariably results in the production of traces of other gases, primarily nitrogen oxides, in addition to the ozone formed. Several other factors including urination and defecation during treatment, sleep, and tendency to attack on aluminum foil plate were also measured. The effect of both types of discharge was to reduce the gross motor activity of the rats. This reduction was statistically significant at the 0.5% level. The tests on the ozone meter showed it to be insensitive to sulfur dioxide and hydrogen sulfide, except at levels far exceeding those encountered in normal and even in polluted atmospheres. Sensitivity to both chlorine and nitrogen dioxide was more pronounced, but neither of these gases could affect the ozone meter at atmospheric concentrations. Dissert. Abstr.

N71-17667 Texas Technological Coll., Lubbock.
AN INVESTIGATION OF THE EFFECTS OF LOW-FREQUENCY VIBRATION ON WHOLE BODY ORIENTATION
Waymon Layton Johnston (Ph.D. Thesis) 1969 235 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 70-1474

Human performance under a low-frequency vibratory environment was investigated. The variables of interest were whole body orientation, response time, and travel time during the movement. Frequencies studied were 0, 2, 5, and 8 cycles per second. Amplitude was held constant at 0.09 inch resulting in acceleration intensities from 0.04 g to 0.58 g. Performance was studied before, during, and after exposure to the vibration environment. Twenty male subjects participated in the investigation in both the sitting and standing body configurations. Vibration exposure times were 20 minutes for all sessions. The task used in this investigation was a body orientation task in which, upon command from a signal display, subjects oriented their bodies as quickly and as accurately as possible towards a series of colored lights serving as targets. The targets were located at angles of 15, 30, and 60 degrees on either side of a zero reference plane and therefore subjects oriented in both clockwise and counterclockwise rotary movements. Dissert. Abstr.

N71-17706* Stanford Univ., Calif.
THEORETICAL STUDIES ON HIGH FREQUENCY WAVE PROPAGATION IN BLOOD VESSELS
John Alexander Hope Bailie (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-1495

A simple plate theory model is utilized to demonstrate that Korotkoff sounds generated during the systolic phase of the auscultatory measurement of blood pressure can be interpreted as a phenomenon of dynamic instability of the partially collapsed brachial artery. Under conditions of instability the brachial segment acts like a mechanical amplifier capable of magnifying certain perturbations inherent in the arterial pressure pulse beyond the audibility threshold. A similar instability phenomenon is also hypothesized as the cause of the sounds heard at systole when the intraluminal pressure exceeds sufficiently the cuff pressure. The theory presented agrees in many respects with evidence obtained from experimental studies on physical models. For large curvatures of the wall and certain types of fluid perturbations, the predicted stability boundaries cannot be explained on physical grounds. Dissert. Abstr.

N71-17830# School of Aerospace Medicine, Brooks AFB, Tex.
ALTITUDE-INDUCED CHANGES IN THE GLUCOSE METABOLISM OF ESCHERICHIA COLI B Interim Report, Nov.1969 -May 1970
Garth E. Ziege Oct. 1970 11 p refs
(AD-715212; SAM-TR-70-69) Avail: NTIS CSCL 6/19

In a study of the effects of altitude on glucose metabolism, respiration of the bacterium Escherichia coli B was measured at ground level and at 10,000 ft, in the presence and absence of glucose. Endogenous (without glucose) QO2 values at ground level and altitude showed no significant difference, thus eliminating

hypoxia as a possible cause of glucose removal. The degree of stimulation of respiration by glucose at altitude exceeded that at ground level, though the variability of results made the differences marginal. Author (GRA)

N71-17880# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF LIMITED MOVEMENT ON THE IMPEDANCE PLETHYSMOGRAPH SIGNAL Preliminary Study, Feb. 1969–May 1970
John W. Yates Sep. 1970 31 p refs
(AD-715211; SAM-TR-70-67) Avail: NTIS CSCL 6/2

The impedance plethysmograph was evaluated as a means of monitoring respiration of personnel in a space-flight environment. Emphasis was placed on studying the effects of limited movement (tapping of electrodes and skin stretching) on the impedance plethysmograph signal. A bridge circuit and servospirometer were used to make extremely sensitive measurements of body impedance change and tidal volume. The linear relationship between tidal volume and thoracic impedance was determined by analog and digital methods. These methods were also used to investigate the amount of interference caused by various body movements on the impedance signal. Possible ways of eliminating error from such artifacts were also studied. Very high linear correlation (r = .85 to .95) was obtained using a bridge circuit. The effects of artifact were reduced by the use of analog filtering, digital programming technics, and a careful choice of display. Author (GRA)

N71-17881# School of Aerospace Medicine, Brooks AFB, Tex.
RETINAL DAMAGE FROM REPEATED SUBTHRESHOLD EXPOSURES USING A RUBY LASER PHOTOCOAGULATOR Final Report, Apr.–May 1970
Gordon L. M. Gibson Sep. 1970 15 p refs
AD-715210; SAM-TR-70-59) Avail: NTIS CSCL 6/18

A ruby laser photocoagulator was used to deliver single and multiple subthreshold exposures to the retina of Macaca mulatta. The subexposures parameters were 0.5-msec. pulse, 1.3-mm.-diameter focal spot, and energy density of about 375 mJ/sq cm. Single exposures produced no microscopic changes on sacrifice at 1 to 30 days following exposure. Repetitive exposures (7 to 17 exposures) at the same energy level invariably caused characteristic damage in the outer retinal layers. These cumulative effects are similar to and more widespread than the minimal-damage lesions produced by single suprathreshold exposures using higher energy density (900 to 1000 mJ/sq cm). Current safety criteria are based on the assumption that laser damage occurs on an all-or-none basis so that damage is not cumulative if a single exposure causes no visible lesion. This work indicates that single subthreshold exposures which are less than half of a threshold dose are cumulative and therefore each subthreshold exposure must damage or in some manner increase the retinal susceptibility to subsequent exposures. Author (GRA)

N71-17885# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF OXYGEN AND DECREASED TOTAL PRESSURE ON TESTICULAR FUNCTION IN THE RABBIT Final Report, Jun.–Aug. 1969
Robert John Russell and Frode Ulvedal Sep. 1970 23 p refs
(AD-715209; SAM-TR-70-53) Avail: NTIS CSCL 6/19

This investigation examined the effects of increased partial pressure of oxygen at reduced total pressure (380 mm. Hg) on testicular function in the rabbit. Ejaculates were collected with an artificial vagina. Ejaculate volume, sperm concentration, percentage of live sperm, percentage of sperm with normal morphology, and sperm motility were measured. At the end of the experimental period the rabbits were sacrificed and gonadal and epididymal sperm reserves were measured. Histologic studies were made on the pertinent organs. Changes were observed in testicular and other sexual functions, although the semen sample variables fell within normal range in all groups. All the rabbits remained healthy throughout the periods of exposure. Author (GRA)

N71-17906*# Sandia Corp., Albuquerque, N.Mex.
PLANETARY QUARANTINE PROGRAM Quarterly Progress Report, Period Ending 31 Mar. 1969
Mar. 1969 22 p refs Sponsored by AEC
(NASA Order R-09-019-040; NASA Order W-12853; NASA Order H-13245A)
(NASA-CR-116430; TID-25077; QPR-12) Avail: NTIS CSCL 06M

Progress is reported on contamination control study, bioburden experimentation and modeling, lunar information system, sterilization modeling, and laboratory support work. Figures are presented to show vertical laminar airflow research facility; number of viable particles per two-minute intervals; and ratio of number of particles vs angle. NSA

N71-17988*# Indiana Univ., Bloomington. Dept. of Microbiology.
INTRODUCTION TO BIOLOGICAL STUDIES
Thomas D. Brock *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 87–91 (See N71-17986 07-13)
Avail: NTIS CSCL 06C

The presence of bacteria in Icelandic hot springs of different temperature and pH values was investigated. The studies show that at neutral and alkaline pH values, bacteria live in springs even at the boiling point, but that there is an upper limit for life processes in springs of higher acidity. Samples of plant stands on Surtsey were taken to test the validity of the hypothesis that blue-green algae are the primary colonizers of virgin land areas. Preliminary analysis indicates that blue-green algae are not the primary colonizers, except in thermal areas where higher plants cannot grow. R.B.

N71-17989*# Oregon Univ., Eugene. Dept. of Biology.
PRELIMINARY REPORT ON THERMOPHILIC BLUE-GREEN ALGAE AND MICROORGANISMS IN ICELAND AND SURTSEY
Richard W. Castenholz *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 92–93 refs (See N71-17986 07-13)
Avail: NTIS CSCL 06C

An earlier study indicated the low number of thermophilic algal species in Iceland's hot springs compared to the hot springs in North America and Europe. Dispersal problems were suggested as the main causes of this situation. Samples were collected in 1970 from several of the same hot springs and in five additional hot spring areas in northern and southwestern Iceland. All samples were examined in a cursory manner and there are no indications of additional species not previously found in Iceland. The samples containing blue-green algae have also been inoculated in appropriate culture media and incubated under conditions that would normally enrich species common to other hot spring areas, as a further check for new species. Author

N71-17990*# Indiana Univ., Bloomington. Dept. of Microbiology.
BIOLOGICAL ASPECTS OF ACID THERMAL WATERS IN ICELAND
William N. Doemel *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 94–95 (See N71-17986 07-13)
Avail: NTIS CSCL 06C

The thermal springs, fumaroles, and soils in Iceland and throughout the world are divided into two general classes which

are distinguished by their characteristic flora and are defined by the pH of their environment, thermal areas with a pH greater than 5.0 and thermal areas with a pH less than 5.0. Thermal areas with a pH greater than 5.0 are referred to as alkaline and those with a pH less than 5.0 as acidic, although this contradicts the chemical definition of alkalinity and acidity. In the alkaline thermal areas of Iceland, the predominant organisms are the blue-green algae and various species of bacteria. In the acid areas, the blue-green algae are absent and the predominant organisms are various species of eucaryotic algae. Bacteria as well as fungi may also be present but represent only a small percentage of the total biomass. Author

N71-17991*# St. Louis Univ., Mo. Dept. of Biology.
SOME PRELIMINARY OBSERVATIONS ON THE INSECTS OF ICELAND AND SURTSEY
Dorothy Feir *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 96–98 (See N71-17966 07-13)
Avail: NTIS CSCL 06C

Hot springs, glaciers and glacial moraines, fresh water and marine environments, large areas of bare rock, and areas covered with vegetation were surveyed for insect life. The survey revealed small numbers of insects, except for the presence of lake midges in large numbers around Lake Myvatn. The effects of continuous light or darkness on insect life are also discussed. R.B.

N71-17992*# Florida State Univ., Tallahassee. Dept. of Oceanography.
MICROBIOLOGICAL STUDIES OF SURTSEY: 1970
Paul A. LaRock *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 99–103 refs (See N71-17966 07-13)
Avail: NTIS CSCL 06M

Ash samples were collected from various locations on Surtsey and processed by conventional bacteriological techniques. The determinations were made to screen the samples for subsequent detailed analysis by photomicrography using colored infrared film, and to estimate the changes in the microbial population since Merek and Young's investigation in 1967. Author

N71-17993*# Nijmegen Univ. (Netherlands). Dept. of Botany.
INFLUENCE OF DEGASSING FROM LAVA ON THE PRIMARY COLONIZATION BY ORGANISMS: A HYPOTHESIS
H. F. Linskens *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 104–108 refs (See N71-17966 07-13)
Avail: NTIS CSCL 06C

Rock samples of various ages were collected and the starting phases of various organisms were studied in the laboratory. Fresh unspoiled surfaces were tested by bringing the substrate in direct contact with the rock surface and adding various types of plant diaspores, and by introducing pieces of lava of various ages into a closed system of covered petri dishes. Preliminary studies show that the outgassing processes from lava influences the primary settlement of organisms. The surface of young lava from Surtsey appears to be unsuitable for attachment and colonization by organisms because of the outgassing process, which renders it antibiotic. R.B.

N71-17994*# Montana Univ., Missoula. Dept. of Botany.
PLANT SUCCESSION AT SKAFTAFELLSJOEKULL
Richard P. Sheridan *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 109–111 (See N71-17966 07-13)
Avail: NTIS CSCL 06C

The development of an ecosystem from an originally unvegetated glacial ice front to a well-developed birch community was studied on the southern coast of Iceland. The outwash plain of Skaftafellsjoekull glacier was surveyed for plant succession. The succession of terrestrial flora on the alluvium is divided into three stages of pioneer, meadow, and early shrub, while that of aquatic flora is limited to green alga in melt water. R.B.

N71-17995*# Hawaii Univ., Honolulu. Dept. of Microbiology.
BIOCHEMICAL DIFFERENTIATION OF EQUISETUM SPECIES FROM ICELANDIC AND NORTH AMERICAN LOCATIONS
Barbara Z. Siegel *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 112–114 (See N71-17966 07-13)
Avail: NTIS CSCL 06C

The reasons for lack of development of endemic species in Iceland are considered. Some of the reasons given are: (1) the mutation rate in the subarctic is slower than that in the subtropics, (2) new organisms have arisen but because of a harsher environment have not found niches in which to survive, (3) that extensive changes have occurred at the subcellular level affecting rates of catalysis and biosynthetic pathways, but may not be reflected at the gross morphological level, and (4) that Iceland is so continually and heavily contaminated by 'continental' organisms that endemics have failed to evolve. Analysis of isoperoxidases and catalases in Equisetum species indicate that although the heme enzymes are morphologically similar, the variation in their number and location is significant. R.B.

N71-17996*# Hawaii Univ., Honolulu. Dept. of Botany.
A ROLE FOR LICHENS AS ANTAGONISTS TOWARD SEED PLANTS
Sanford M. Siegel *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 115 (See N71-17966 07-13)
Avail: NTIS CSCL 06C

The hypothesis that lichens break down rock surfaces and prepare the way for ferns and seed plants is considered. Preliminary studies of lichens collected from a lava lake area of Iceland reveal a growth inhibitor activity on barley seeds. This phenomenon is similar to that observed for some other geographic species of lichens. R.B.

N71-17997*# Hawaii Univ., Honolulu. Dept. of Botany.
DWARFING, LIGNIFICATION, AND LAND PLANT EVOLUTION
Sanford M. Siegel *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 116 (See N71-17966 07-13)
Avail: NTIS CSCL 06C

The relationship of lignin content to height in dwarf and giant variants of alpine plants is considered. Dwarf forms of regular-sized plants from Iceland are compared with their closest relatives of larger size for height and lignin content. R.B.

N71-17998*# Hawaii Univ., Honolulu. Dept. of Microbiology and Botany.
SEARCH FOR A PRECAMBRIAN RELICT MICROORGANISM, KAKABEKIA BARGHOORNIANA
Barbara Z. Siegel and Sanford M. Siegel *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 117–121 (See N71-17966 07-13)
Avail: NTIS CSCL 06M

Kakabekia barghoorniana is defined as a living microorganism, morphologically similar to a form first described as a fossil from the Gunflint chert of south Ontario and dated at about two billion

years. Studies were conducted on the moss- and turf-covered slope below the palagonite-covered sea-floor outcrops near Reykjavik, Iceland and other areas of the island to determine the existence of the relict form. The presence of the microorganism in Iceland indicates a longitudinal range of about 150 deg and a latitudinal range of about 18 deg in the northern latitudes. R.B.

N71-17989*# Oregon Univ., Eugene. Dept. of Biology.
PRELIMINARY REPORT ON THE DISPERSAL OF THERMOPHILIC ALGAE TO SURTSEY
Conrad E. Wickstrom *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 122–124 refs (See N71-17986 07-13)
Avail: NTIS CSCL 06C

The water transport scheme for dispersal of thermophilic microorganisms to Surtsey from the mainland is discussed. The water transport scheme is suggested as the most likely mechanism because of fewer organisms found in rain and air samples, it provides a constant inoculum, it is a more direct route for the inoculum with fewer chance events, and the environmental conditions during water transport seem to be less severe than during air transport. R.B.

N71-18056*# Sandia Corp., Albuquerque, N.Mex. Planetary Quarantine Dept.
PLANETARY QUARANTINE PROGRAM Quarterly Progress Report, Period Ending 31 Dec. 1970
Dec. 1970 63 p refs
(NASA Order W-12853; Proj. 0064010)
(NASA-CR-116420; QPR-19) Avail: NTIS CSCL 06M

The following activities are discussed: (1) oxygen dependency in radiation inactivation of organisms at elevated temperatures; (2) formation of a model for thermoradiation inactivation of spores that includes a term representing breakage; (3) a behavioral model for spore inactivation as a function of water activity; and (4) a computerized bioassay identification system for Apollo 10, 11, 12 and 14 spacecraft biological data. G.G.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N71-16909# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N.Mex.
EVALUATION OF SLEEP, PERFORMANCE AND PHYSIOLOGICAL RESPONSES TO PROLONGED DOUBLE CREW FLIGHTS. C-8 OPERATION COLD SHOULDER: A PRELIMINARY REPORT
Vernon Pegram, William Storm, Bryce O. Hartman (School of Aerospace Med.), D. A. Harris (School of Aerospace Med.), and Henry B. Hale (School of Aerospace Med.) *In* AGARD Rest and Activity Cycles for the Maintenance of Efficiency of Personnel Concerned with Mil. Flight Operations Nov. 1970 16 p refs (See N71-16905 07-04)
Avail: NTIS

A real-world experiment designed to determine the effects on aircrewmen of marrying two crews to a jet transport and flying operational missions is reported. Two basic crews were flown in a C-141 aircraft, utilizing either a 4/4 or 16/16 work/rest cycle. A battery of measures were conducted on each crew (a) oral temperature, (b) endocrinemetabolic trends, (c) electroencephalogram (EEG) for determining sleep, and (d) crew performance evaluations. The oral temperature data showed that flight per se induced a low-grade hypothermia which was more pronounced in individuals occupying key crew positions. The endocrinemetabolic data tentatively suggested that the aircraft commanders, as a group, experienced more stress than the other crewmembers. The sleep EEG analysis showed that both human and primate subjects suffer a significant reduction in deep sleep and dream sleep when exposed to actual or simulated flight conditions. When combined with the sleep and physiological changes, the performance data from both humans and primates suggests caution in the application of in-flight double crews. Author

N71-16978# Joint Publications Research Service, Washington, D.C.
THE OPERATION OF THE VESTIBULAR ANALYZER
14 Jan. 1971 34 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, 1970 p 643–659, 673–678
(JPRS-52173) Avail: NTIS

CONTENTS:

1. MODERN VESTIBULOMETRIC CHAIRS AND STANDS FOR THE OBJECTIVE STUDY AND TRAINING OF THE VESTIBULAR ANALYZER S. S. Markaryan p 1–23 refs (See N71-16979 07-05)
2. MODIFICATION OF RATE OF VESTIBULAR COMPENSATORY PROCESS IN RELATION TO POSITION OF HEAD IN SPACE A. A. Shipov et al p 24–33 refs (See N71-16980 07-04)

N71-16979# Joint Publications Research Service, Washington, D.C.
MODERN VESTIBULOMETRIC CHAIRS AND STANDS FOR THE OBJECTIVE STUDY AND TRAINING OF THE VESTIBULAR ANALYZER
S. S. Markaryan *In its* Operation of the Vestibular Analyzer 14 Jan. 1971 p 1–23 refs (See N71-16978 07-05)
Avail: NTIS

Vestibulometric chairs and stands that allow dosaged (subthreshold, threshold, and transthreshold) stimulation of the vestibular analyzer were devised. The designs of the chairs and stands provide for a wide range of angular rotation and acceleration and vertical up-and-down movements during applied speeds and accelerations, coriolis-type accelerations, positioning of a person in any position in relation to the axis of rotation, minimal noise level, absence of external light (where necessary) and air currents, continuous sound and light communication between subject and physician, maximal number of recording parameters. The indicated equipment makes it possible to investigate vestibular, visual, and proprioceptive analyzers either individually or in combination. Author

N71-17099# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
CABIN AIR REQUIREMENTS FOR CREW COMFORT IN MILITARY AIRCRAFT
T. L. Hughes London Aeron. Res. Council 1970 76 p refs Supersedes RAE-TR-68304; ARC-31220
(ARC-CP-1094; RAE-TR-68304; ARC-31220) Copyright. Avail: NTIS; HMSO: 85p; BIS: $3.40

The effects of various crew and aircraft parameters on cabin air supply requirements are discussed. The relationships between these parameters are given in the form of design curves and their validity is discussed. The relative importance of the factors influencing cabin air requirements were studied and recommendations are made on possible cockpit improvements. Author (ESRO)

N71-17344*# George Washington Univ., Washington, D.C. Biological Sciences Communication Project.

A REPORT ON THE SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH IN TECHNOLOGY UTILIZATION

John Johnston 23 Oct. 1969 107 p refs Conf. held at Greenbelt, Md., 23 Jun. – 29 Aug. 1969

(Contract NSR-09-010-057)

(NASA-CR-116410) Avail: NTIS CSCL 06A

A chronicle is presented of the planning, development, and management of the Summer Institute. The material is aimed at providing some of the input necessary to evaluate the Summer Institute in terms of meeting its objectives, NASA/TUD's objectives, and general educational goals. D.L.G.

N71-17410*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SURFACE CHARACTERISTICS OF USED HIP PROSTHESES

Max A. Swikert and Robert L. Johnson Washington Feb. 1971 13 p refs

(NASA-TN-D-6153; E-5915) Avail: NTIS CSCL 06B

McKee-Farrar total hip prostheses removed from patients after relatively short service were subjected to critical examination for surface characteristics. Evidence suggested that the wear process was initiated by adhesion and subsequently progressed to abrasive wear. Wear tended to be concentrated in isolated areas, suggesting localized load bearing areas and lack of conformability of the femoral ball and the acetabular socket. Measurement of unworn areas indicated the initial geometric variations to be greater than would be expected in precision bearing fabrication. Author

N71-17440*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FEASIBILITY OF MINIATURIZING A HEATER FOR A THIN-FILM OXYGEN PARTIAL-PRESSURE SENSOR

Carl R. Pearson Washington Feb. 1971 16 p refs

(NASA-TN-D-6134; L-6999) Avail: NTIS CSCL 14B

The feasibility of using a miniature heater for a zinc oxide thin-film oxygen partial-pressure sensor was investigated. A silicon heater 0.25 millimeter square by 13 millimeter long was used to obtain the desired operating temperature for the zinc oxide film, 650 K. Experimental data are presented for the resistance-temperature characteristics, the temperature distribution, and power requirements of the heater. Results show the temperature of the heater can be determined by the change in resistance of the heater at its operating temperature. The work also indicates that this heater concept is feasible, but more effort will be required to deposit the zinc oxide film on the heater surface. Author

N71-17442*# Oakland Univ., Rochester, Mich. School of Engineering.

BIOSYSTEMS ENGINEERING RESEARCH. VOLUME 2: AN INVESTIGATION OF TWO HYBRID COMPUTER IDENTIFICATION TECHNIQUES FOR USE IN MANUAL CONTROL RESEARCH Final Report, 15 Mar. 1969 – 30 Jun. 1970

G. A. Jackson Nov. 1970 106 p refs

(Grant NGR-23-054-003)

(NASA-CR-116514; TR-70-6) Avail: NTIS CSCL 05H

Two hybrid computer techniques for the identification of the gain and time delay parameters of the crossover model of a compensatory control system are discussed. These techniques were specifically developed to perform accurate parameter identification when limited amounts of input-output data are available from the system being identified. The methods are thus useful in those cases where it is desired to know the system parameters that existed over a short time span, and there is not enough input-output data for identification by pure analog, or pure digital, means. One method is a hybrid version of the continuous parameter tracking method, while the second is a modified stochastic approximation method. With proper programming either method can be used as an on-line device which will continually yield those average parameter values which existed over the last fifteen seconds of operation. Author

N71-17592*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ENERGY TRANSFER RATES OF AN INTEGRATED LIFE SUPPORT SYSTEM DURING MANNED AND INTERMITTENTLY MANNED TESTS

O. Karl Houck Washington Feb. 1971 29 p refs

(NASA-TN-D-6207; L-7482) Avail: NTIS CSCL 06B

The identification and distribution of thermal and electrical energies within a typical life support system have been determined from data obtained from manned and intermittently manned tests of an integrated life support system (ILSS) at the Langley Research Center. Less than one-half of the energies supplied to the ILSS were directly used for its operation, with the remainder being lost as heat within the equipment plumbing and the test-chamber atmosphere or transferred through the test-chamber wall. The normal ILSS cyclic subsystem and unit operation and the energy coupling between thermal transport fluids produced minor fluctuations in the test-chamber atmosphere temperature. These findings are significant for the development of subsystem designs, fluid transport plumbing, and accessory equipment to improve energy utilization and demands of regenerative life support systems. Author

N71-17593*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PNEUMATIC ARTIFICIAL HEART DRIVING SYSTEM PROVIDING QUASI-STEADY-STATE REGULATION AND PRESSURE WAVEFORM CONTROL

John A. Webb, Jr., Michael J. Crosby, and Miles O. Dustin Washington Feb. 1971 28 p refs

(NASA-TN-D-6171; E-5827) Avail: NTIS CSCL 06B

The design of an artificial heart control system for reproducing the pumping and flow regulating functions of the natural heart is presented. The quasi-steady-state characteristics of the natural heart are reproduced in an artificial heart by means of feedback control. The system also uses a specially designed servovalve to provide adjustable pressure waveforms. Average position drift of the pumping element is minimized by feedback control. An analog computer in the driving system provides flexible control and monitoring capabilities. Author

N71-17599* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

BIOLOGICAL ISOLATION GARMENT Patent

Fred R. Spross, inventor (to NASA) Issued 23 Jun. 1970 (Filed 9 Sep. 1969) 11 p Cl. 128-142.5; Int. Cl. A62b7/00

(NASA-Case-MSC-12206-1; US-Patent-3,516,404; US-Patent-Appl-SN-856258) Avail: US Patent Office CSCL 06K

A completely enclosable, one piece human garment fabricated primarily from a tightly woven, permeable cotton fabric with all seams internally sealed is described for contamination proof wearing apparel. Medical rubber gloves are sealed to the ends of the arms for hand coverings, and the headpiece includes a full width visor for wearer vision and an integral oronasal respirator for filtering the wearer's inspired and expired breath. Size adjustments are provided on the legs and torso for adaptation of the garment to different sizes, and a pressure-sealing closure zipper extends diagonally from the crotch across the chest and curves over one ear to the top of the headpiece for donning and removing the garment. NASA

N71-17699# RAND Corp., Santa Monica, Calif.
COMMENTS ON CYBERNETICS AND MANAGEMENT OF LARGE SYSTEMS
E. C. De Land Mar. 1970 11 p Presented at the Symp. on Global Systems Dyn., Charlottesville, Va., 17 – 19 Jun. 1969
(AD-715251; P-4303) Avail: NTIS CSCL 5/11

The document comments on the premise that a technologist has a citizens responsibility to contribute to and attempt to develop a rational social structure. At the same time there must be a way to leave responsible room for the Arts and Letters, for human needs and feelings, for human fallibility, and for human genius. In short, there must be a way for humans living within a technological society to maintain the upper-hand over the machine and over the organization. Author (GRA)

N71-17750# School of Aerospace Medicine, Brooks AFB, Tex.
A THIRD STUDY OF FACTORS AFFECTING AIRCREW MORALE Final Report, Sep. 1969 – Apr. 1970
Richie S. Dryden, Leonard J. Kirschner, and Bryce O. Hartman Oct. 1970 19 p refs
(AD-715015; SAM-TR-70-55) Avail: NTIS CSCL 5/10

A survey of morale and job satisfaction in helicopter aircrewmen of the Aerospace Rescue and Recovery Service was conducted as part of a worldwide, on-site investigation of accident trends. Analysis of forms returned by 253 officers and 228 enlisted aircrewmen yielded the following findings: (a) additional duties were an area of concern for both officer and enlisted aircrewmen; (b) scheduled time off was reported as the second major problem area; (c) overall levels of job satisfaction were somewhat lower than in the two earlier studies. Author (GRA)

N71-17763# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
FLARE RANGE ESTIMATION: EVALUATION OF AIDS
Robert L. Hilgendorf and John C. Simons Feb. 1970 48 p refs
(AD-715287; AMRL-TR-69-128) Avail: NTIS CSCL 17/8

Devices for estimating the range to a simulated pyrotechnic flare were evaluated against several unaided conditions. Two devices based on a photometric concept and two based on a geometric concept were used. One was a human-engineered triangulation device (Ritchie Ranger modified). The errors of naked eye judgments are discussed. Also discussed are technological requirements for operational ranging devices and future plans for an inflight evaluation of methods for flare range estimation. Author (GRA)

N71-17945*# Esso Research and Engineering Co., Linden, N.J. Government Research.
INVESTIGATION OF HEATLESS DESORPTION TECHNOLOGY FOR CARBON DIOXIDE CONTROL IN MANNED SPACECRAFT
Martin Lieberman and Alvin Skopp [1970] 101 p refs
(Contract NAS1-9356)
(NASA-CR-111815; GR-2055-70) Avail: NTIS CSCL 06K

The results are described of an investigation to improve the cyclic process of physical adsorption for removing carbon dioxide and water vapor from air using molecular sieve and silica gel sorbents. Heatless Desorption, a fractionation process not requiring the addition of heat energy, was investigated to develop system design criteria appropriate for manned spacecraft application. Primary emphasis was given to evaluating: (1) Low purge-to-feed ratios, low space velocity, and a composite bed of two sorbers for water vapor removal, and (2) the use of purge gas which would otherwise be vented to vacuum to increase the rate of vacuum desorption of CO2. The use of Heatless Desorption for air conditioning in space without a radiator or refrigerant was examined. Potential applications of Heatless Desorption were studied including an add-on water save system for the primary Skylab vacuum desorbed system. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 2 Propellants.

N71-16961# Academia R. P. R., Cluj. Inst. de Chimie.
STUDIES ON URANYL CHLORIDES [STUDII ASUPRA CLORURILOR DE URANIL]
Constantin Mirel (Ph.D. Thesis) 1968 18 p refs In RUMANIAN
(NP-18248) Avail: AEC Depository Libraries

After a survey of studies on uranyl chlorides up to 1967, experiments on methods for the preparation of these compounds are presented. The trichloride, given in the literature as $UO_2Cl_2 \cdot HCl \cdot H_2O$ may be considered a tetracoordinated compound $(UO_2Cl_3H_2O) \cdot H \cdot H_2O$. Chlorination of UO_3 in organic media possessing a low dielectric constant yielded $UO_2Cl_2 \cdot H_2OO$. The operation in other solvents, CH_3OH, C_2H_4OH, C_3H_6O or $(C_2H_5)_2O$, yielded solvates of $UO_2Cl_2 \cdot H_2O$. A new component, $UO_2(CH_3COO)_2 \cdot 2HCl$, was obtained by chlorinating $UO_2(CH_3COO)_2$ in low dielectric constant solvents. Removal of HCl from $UO_2(CH_3COO)_2 \cdot 2HCl$ takes place at two different temperatures, indicating that the two HCl molecules are not bound in the same manner. In the extraction with TBP and TEP, the excess chlorides exert a positive effect on the partition coefficient through a mechanism involving the dehydration of the medium and the common ions. NSA

N71-16998# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE INFLUENCE OF IMPURITIES ON THE RESULTS OF DETERMINING MICROELEMENTS USING THE ATOMIC-ABSORPTION METHOD [O VLIYANII POSTORONNIKH PRIMESEY NA REZULTATY OPREDELENIYA MIKROELEMENTOV ATOMNO-ABSORBTSIONNYM METODOM]
M. A. Kabanova et al Apr. 1970 8 p refs Transl. into ENGLISH from Khim. Sel. Khoz. (Moscow), v. 7, 1969 p 72 – 75
(Rept-(D-5)-70-05) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The effects of K, Na, Ca, Mg, Al, and Fe impurities on Cu, Ni, Co, Zn, and Mn microelements were investigated for analysis of soil mixtures. The effects of large amounts of impurities and the total effect of the impurities, HCl, and a buffer solution of ammonium acetate on the absorption of microelements were studied. The addition of acetic acid increased accuracy of the analysis, and a hydrochloric acid medium in the analytical solution masked the negative effect of macrocomponents of the soil mixtures. N.E.N.

N71-17060# State Univ. of New York, Stony Brook. Dept. of Chemistry.
THEORETICAL STUDIES OF THE GROUND AND EXCITED ELECTRONIC STATES OF THE BENZYNES BY AB INITIO SCF AND CI METHODS
D. L. Wilhite and J. L. Whitten [1970] 25 p refs
(Grant NSF GP-7875)
Avail: Issuing Activity

Ab Initio self-consistent-field (SCF) and configuration interaction (CI) calculations on ortho-, meta- and para-benzyne are reported for the molecules in a geometry constrained to be that of benzene. The results predict conclusively that the ground electronic state of ortho-benzyne is a singlet. The meta- and para- isomers are found to have triplet ground states in the geometries considered; however, the singlet-triplet energy separations are quite small. Electronic spectral calculations for ortho-benzyne show the existence of both neutron-neutron and pi-neutron states near the region of the

experimentally observed intense absorption: also a pi-neutron transition is found at longer wavelength. Author

N71-17069# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALYTICAL CONDITIONS OF DETERMINING TRACES OF IMPURITIES IN HIGH-PURITY MATERIALS BY ANODIC STRIPPING VOLTAMETRY [OB USLOVIYAKH PROVEDENIYA ANALIZA PRI OPREDELENII SLEDOVYKH KOLICHESTV PRIMESEY V MATERIALAKH VYSOKOY CHISTOTY METODOM AMALGAMNOY POLYAROGRAFII S NAKOPLENIYEM]
L. P. Trushina et al May 1970 13 p refs Transl. into ENGLISH from Izv. Tomsk. Politekh. Inst. (USSR), v. 164, 1967 p 237-243
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

In determining traces of different elements in high-purity materials both a contamination and a loss in the test sample during analysis may occur. Analysis of high-purity materials using the method of anodic stripping voltametry, just as in the majority of others, may be done in a series of steps such as: (1) Preparation of the sample for analysis, (2) Treating the sample, and (3) Direct determination of the impurity in the high-purity materials. At all stages of analysis it is very important to avoid the possibility of contamination and loss in the test sample. Sources of contamination may be: (1) The reagents used: water used for dissolving the sample and preparation of standard solutions, (2) The container used in all stages of the analysis, and (3) The laboratory air containing microscopic impurities of many elements. In working with small amounts of materials it is also possible that losses in impurities will take place, produced by anomalous volatility and adsorption of them on the walls of the container. Author

N71-17078# Rice Univ., Houston, Tex. Dept. of Chemistry.
MICROWAVE SPECTRUM, CONFORMATION, AND DIPOLE MOMENT OF DIVINYL ETHER
Chiaki Hirose and R. F. Curl, Jr. [1970] 22 p refs
(Grant NSF GP-6305)
Avail: Issuing Activity

The microwave spectrum of divinyl ether was investigated and a, b, and c-type rotational transitions of one conformer was assigned. This conformer has rotational constants closely related to the cis-trans planar form. The inertial defect and dipole moment reveal that it is not planar. This nonplanarity results because of strong repulsion between the beta hydrogen of the cis vinyl group and the alpha hydrogen of the trans vinyl group. The c-type transitions are split 53 MHz by inversion tunneling. The dipole moment was obtained from Stark effect measurements and is 0.782 debye. Author

N71-17079# State Univ. of New York, Stony Brook. Dept. of Chemistry.
CONFIGURATION INTERACTION STUDIES OF GROUND AND EXCITED STATES OF POLYATOMIC MOLECULES. 2: THE ELECTRONIC STATES AND SPECTRUM OF PYRAZINE
Melvyn Hackmeyer (Mich. State Univ.) and J. L. Whitten [1970] 33 p refs
(Grant NSF GP-18121)
Avail: Issuing Activity

Ab initio SCF and CI treatments of the ground state and n yields pion* and pion yields pion* excited states of pyrazine are reported for the molecule in its ground state equilibrium geometry. In the case of n yields pion* transitions, the two symmetry combinations of nitrogen lone pair orbitals n1 and n2 are found to correspond to the description n(+) approximately equal n1+n2+ lambda sigma and n(-) approximately equal n1-n2 in which the n(+) orbital has the higher orbital energy and is significantly more delocalized than n(-) by interaction with the pyrazine ring sigma system. This result leads to a significant splitting at the CI level of description of 1.4 eV between the B(3u) and B(2g) excited states which are derived from the orbital promotions n(+) yields pion* and n(-) yields pion*, respectively. Calculated transition energies to the lowest yields pion* excited states 3B(3u) and 1B(3u) of 3.56 and 4.22 eV, respectively, are in good agreement with experimental values. Author

N71-17088# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
KINETIC BEHAVIOR OF THE HO2 RADICALS AND THEIR ACID FORM WITH RESPECT TO THE FERROUS AND FERRIC IONS
Jacques Pucheault et al Sep. 1970 13 p refs Transl. into ENGLISH from Int. J. Radiat. Phys. Chem. (England), no. 1, 1969 p 209-218
(LIB/Trans-282) Avail: AEC Depository Libraries

Results from the radiolysis of the system Fe(II)/Fe(III) in the presence of air and sulfuric or perchloric acid indicated an apparent influence of pH on the oxidation and reduction rates in this system by the HO2 radical. It was concluded that this effect is due to the existence of an acid form of the radical HO2 which oxidizes ferrous ions while HO2 reduces the different forms of the ferric ion. The ratios of the corresponding rate constants were found to be k sub 4/k sub 1b = 0.0016 mole/1, k sub 2/k sub 3 = 1.20 for the sulfuric acid medium. Author (NSA)

N71-17091*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE PHOTOLYSIS OF N2O AT 1470 A. IONOSPHERIC RESEARCH
Marcia C. Dodge and Julian Heicklen 30 Dec. 1970 30 p refs
(Grants NGL-39-009-003; NSF GA-12385)
(NASA-CR-116442; SR-366) Avail: NTIS CSCL 04A

The photolysis of pure N2O, N2O and N2, and N2O and C3H6 mixtures at 1470 A and room temperature has been studied to determine the relative importance of the primary processes. Reported are quantum yield measurements for the photolysis of pure N2O, N2O-N2 mixtures, and N2O-olefin mixtures. It is shown that the metastable N(2D) is not deactivated by N2O, but is removed by chemical reaction to produce N2 and NO. The results further indicate that N2(3 sigma) dissociates N2O at least 80% of the time during quenching. The relative efficiency of N2O compared to N2 is about 2 for the removal of O(1D). O(1S) is removed about 90 times as efficiently by C3H6 as by N2O. Author

N71-17093# Royal Aircraft Establishment, Farnborough (England).
THE THERMAL DEGRADATION OF PERFLUOROPOLYPYRIDINE
J. L. Cotter, H. Dickinson, G. J. Knight, and W. W. Wright Jan. 1970 17 p refs
(RAE-TR-70005) Copyright. Avail: NTIS

The thermal degradation of perfluoro polypyridine was studied in inert and oxidizing atmospheres by thermogravimetric techniques. Volatile products were analyzed mass spectrometrically and the fluorine yield also determined. The stability of the polymer on a weight loss basis was better than polytetrafluoro ethylene in inert atmospheres, but rather worse in oxidizing atmospheres. The major breakdown route involves removal of fluorine from the heterocyclic nucleus. Author (ESRO)

N71-17123# Missouri Univ., Columbia. Dept. of Chemistry.
AUTOMATED POTENTIOMETRIC TECHNIQUES FOR THE ON-SITE MONITORING OF IONS IMPORTANT IN WATER QUALITY CONTROL

Stanley E. Manahan 1970 14 p refs
(Contract DI-14-31-0001-3025)
(PB-195167; W71-00474) Avail: NTIS CSCL 07D

The characteristics of the nitrate electrode fluoride electrode cell without liquid junction were investigated for applicability to nitrate ion analysis. In addition to enabling accurate nitrate analysis, the cell was found to be useful for examining the effects of interfering ions. An attempt was made to use the nitrate electrode in following nitrate ion uptake by algal cultures. The algae interfere to a certain extent with the electrode response. Using knowledge gained from this research a potentiometric nitrate analysis capability has been set up at the new University of Missouri Environmental Trace Substances Laboratory. Author (GRA)

N71-17162# Nebraska Univ., Lincoln. Dept. of Chemistry.
REACTIONS OF SELECTED HALOGENS AND INTERHALOGENS ACTIVATED BY RADIATIVE NEUTRON CAPTURE AND ISOMERIC TRANSITION WITH CONDENSED STATE CYCLOPENTANE AND AROMATIC HYDROCARBONS
Ernest John Kemnitz, Jr. (Ph.D. Thesis) 1970 127 p refs
(Contract AT(11-1)-1617)
(COO-1617-26) Avail: NTIS

Cyclopentane, benzene, and selected alkylbenzenes were probed both in the liquid and solid phases with nuclear processes induced by the neutron activation of one or more of the following species: I2(127), I2(129), Br2, IC1, and IBr. Of particular interest in each of the systems were: isotope effects due to radiative neutron capture (n,gamma) and isomeric transition (IT) processes, individual and comparative scavenging effects in the liquid phase systems of the various halogens and interhalogens, crystalline structure at 77 K, and, product distributions of organic halides. The organic yields due to the I(127)(n-gamma)I(128) and I(130m)(IT)I(130) processes in liquid cyclopentane were about 1.2 times greater than those due to the I(129)(n-gamma) I(130) + I(130m) processes, whereas no differences were found when benzene and alkylbenzene were used as solvents. The product distribution was seemingly independent of the nuclear process in all the solvents employed. Author (NSA)

N71-17225# Farnham (Frank C.) Co., Philadelphia, Pa.
DETERMINING THE SURFACE CONCENTRATION OF ION ADSORBATES WITH THE AID OF A TWO-ELECTRODE THIN-LAYER METHOD
E. Schmidt et al 19 Oct. 1970 19 p refs Transl. into ENGLISH from Helv. Chim. Acta (Basel), v. 52, no. 8, 1969 p 2245–2255 Prepared for Mound Lab.
(Contract AT(33-1)-GEN-53)
(MLM-1765(TR)) Avail: NTIS

A method for the investigation of ion adsorbates on ideally polarizable electrodes is described, in which an additional generator electrode which operates reversibly with respect to the adsorbable species is in contact with the electrolyte phase and maintains a constant activity of the components in question in this phase. Changes in surface concentration are then converted into Faraday currents at the generator electrode, which can readily be measured and used for the determination of Gamma-isotherms. The use of a thin layer method is recommended for the practical performance of experiments of this type. Using this method, the surface concentration of Pb on Ag electrodes in perchlorate solution was determined. The Gamma-values obtained can be represented as single-valued functions of the difference between the potentials of the adsorbate-forming and generator electrodes, and thus correspond to the well known metal monolayer model. Author

N71-17317# General Electric Co., Syracuse, N.Y. Semiconductor Products Dept.
AUGER SPECTROSCOPY AND SILICON SURFACES
J. H. Affleck *In* NBS Silicon Device Process. Nov. 1970 p 450–456 refs (See N71-17276 07-26)
Avail: SOD $5.50

The basic principles of Auger spectroscopy, the equipment required, and how it may be applied to silicon surfaces are reviewed. A number of problems are examined such as the effectiveness of surface cleaning, residues of photoresist material and various solvents, the effect of the processing environment on surface properties, and the identity of contaminating films. Several examples of the application of Auger analysis to semiconductor problems are cited. Author

N71-17363*# Pittsburgh Univ., Pa. Space Research Coordination Center.
REACTIONS OF Na(+), K(+), AND Ba(+) IONS WITH O2, NO, AND H2O MOLECULES
R. Johnsen, H. L. Brown, and Manfred A. Biondi Jan. 1971 16 p refs Submitted for publication
(Grant NsG-416; Contract DA-31-124-ARO(D)-440)
(NASA-CR-116501; SRCC-147; APP-26) Avail: NTIS CSCL 07D

Ion molecule reactions of sodium, potassium, and barium ions with O2, NO, and H2O were studied in a drift tube mass spectrometer apparatus. The rate constants or upper limits obtained are given and the consequences of these results for the D and E region of the upper atmosphere are described. Author

N71-17638 Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Elastomer Chemicals Dept.
NA-101: A DELAYED ACTION ACCELERATOR FOR NEOPRENE
D. H. Geschwind and R. S. Tobey 1970 4 p *Its* Du Pont Chem. for Elastomers Bull. No. 63
Copyright. Avail: Issuing Activity

NA-101 is described as providing a combination of excellent processing safety, a very fast cure rate, and a high state of cure in all types of Neoprene compounds. It can be used alone or in combination with secondary accelerators to obtain variations in processing safety, green stock stability, and rate or state of cure. Author

N71-17663# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
KINETICS AND MECHANISM OF THE REACTION OF (3P) WITH CARBON MONOXIDE
R. Simonaitis and Julian Heicklen 15 Sep. 1970 28 p refs
(Grant NSF GA-12385)
(SR-363) Avail: Issuing Activity

The mercury photosensitized decomposition of N2O [to produce O(3P)] was studied in the presence of mixtures of CO and 2-trifluoromethylpropene (TMP) at 298, 383, and 472 K to determine the relative rate constants for the reaction of O(3P) with the two gases. The absolute value of the rate constant with TMP was found to be 9.1 × 10 to the 9th power from a similar competitive study at the same temperatures between TMP and butene-1, whose rate constant with O(3P) is relatively well known. The absolute value for the O(3P) + CO reaction was thus determined, and it was found to depend on pressure. The reaction was intermediate between second and third order. For any pressure, the reaction became more nearly second order as the temperature was raised. Author

N71-17664# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Elastomer Chemicals Dept.
DELAYED ACTION ACCELERATION OF ENOPRENE COMPOUNDS WITH NA-101

D. H. Geschwind [1970] 24 p
(SD-153; A-73657) Avail: NTIS

A delayed action, general purpose accelerator for all types of Neoprene is described that combines excellent processing safety with the high vulcanizate quality and heat resistance normally associated with compounds accelerated with NA-22. In many compounds of Neoprene, it is thus possible with NA-101 to achieve even better resistance to compression set than can be obtained with NA-22. Processing safety, green stock bin stability, cure rate and cure state can be modified by the addition of secondary accelerators such as thiurams, thiazoles, or sulfenamides. Author

N71-17676*# Esso Research and Engineering Co., Linden, N.J. Government Research Lab.
STUDY OF SYNTHESIS OF GLYCEROL Annual Report, 12 Feb. - 15 Nov. 1970
C. M. Kouidri and W. F. Taylor 15 Nov. 1970 186 p refs
(Contract NAS2-4496; ESSO Proj. 4320)
(NASA-CR-114276; GR-10-SSG-70) Avail: NTIS CSCL 07D

The approach to edible polyol synthesis, based on driving the formaldehyde condensation reaction to the C5-C6 carbohydrate stage followed by reductive cleavage to glycerol and propylene glycol, is discussed. Conditions for the hydrogenolysis reaction of formose mixtures were obtained by studying the catalytic reductive cleavage reaction of neat carbohydrates. The results show that, while ruthenium on carbon used in conjunction with Ca(OH)2 produced the largest quantities of edible polyols, it also promoted the hydrogenation of the pentose and hexose materials. Separation by fractional distillation of glycerol from the hydrogenolysis product mixture was accomplished. The presence of materials which decompose near the distillation temperature of glycerol prevented collection of a pure sample. Author

N71-17705* Hazleton Labs., Falls Church, Va.
LYOPHILIZED REACTION MIXTURES Patent
Emmett W. Chappelle, inventor (to NASA) Issued 21 Jan. 1969 (Filed 3 Aug. 1966) 3 p Cl. 195-99; Int. Cl. C12k1/04; Int. Cl. F21k2/00 Sponsored by NASA
(NASA-Case-XGS-05532; US-Patent-3,423,290; US-Patent-Appl-SN-570093) Avail: US Patent Office CSCL 07D

A method is described for lyophilization of luciferase-containing mixtures which produce stable, dry powders. The product obtained is a lyophilized mixture of luciferase, luciferin, serum albumin, and a source of magnesium ions to act as a catalytic agent in the luciferin-ATP reaction. The enzyme luciferase is derived from desiccated firefly tails by an extraction technique with final purification by column chromatography. The compound is used in life detection reactions. R.B.

N71-17754# Vermont Univ., Burlington. Dept. of Physics.
INTERACTION OF MOLECULES WITH SOLID SURFACES Final Report, 1 Oct. 1965 - 30 Sep. 1970
Albert D. Crowell Oct. 1970 10 p refs
(Grants AF-AFOSR-1388-68; AF-AFOSR-0993-66)
(AD-715283; AFOSR-70-2626TR) Avail: NTIS CSCL 7/4

The report describes research concerned primarily with the effects of chemisorption of CO on molybdenum surfaces. Samples of molybdenum were outgassed in ultra high vacua and exposed to the gas under study. In the case of CO, the molecules were tagged with 14C to permit the determination of the number of molecules on the surface. Binding energies for these molecules were found by combining radiotracer measurements with thermal desorption studies. A new technique of analyzing the photoelectric yields which shows promise of leading to greater understanding of electronic changes produced at metal surfaces by gas adsorption has been developed. The method is based experimentally upon the identification of electron emitted from the surface by vectorial effects and theoretically upon a model which includes an explicit excitation mechanism. Studies of the changes in the electrical conductivity of evaporated metal films due to gas adsorption have been conducted both by DC and AC techniques. A new computer technique has made possible the characterization of the AC properties of thin films in terms of a simple equivalent circuit with frequency independent parameters. Author (GRA)

N71-17849# Cornell Univ., Ithaca, N.Y. Materials Science Center.
MATERIALS SCIENCE CENTER Quarterly Report No. 14
31 Dec. 1969 63 p Supported in part by ARPA, AEC, ARO, NIH, NSF, OSW, ONR
(AD-715081; QR-14) Avail: NTIS CSCL 7/4

The report presents abstracts of current research at the Materials Science Center of Cornell University. The topics covered include all phases of chemistry. GRA

N71-17890# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
COMPARISON OF 3d CLASSICAL TRAJECTORY AND TRANSITION-STATE THEORY REACTION CROSS SECTIONS
G. W. Koeppl and M. Karplus 1970 6 p refs Sponsored in part by AEC
(HUX-3780-29) Avail: NTIS

Results obtained on an extended LEPS surface for a thermo-neutral reaction with a well defined asymmetric barrier are presented. The surface parameters are chosen so that the barrier is in the entrance valley for the forward reaction (A + BC yields AB + C), and in the exit valley for the backward reaction (C + BA yields CB + A). Calculations are made for the average cross sections, and deviations from those of the transition state theory are discussed. N.E.N.

N71-17891# Harvard Univ., Cambridge, Mass.
THEORETICAL STUDIES IN CHEMICAL KINETICS Annual Report, 1970
Martin Karplus 1970 5 p refs
(Contract AT(30-1)-3780)
(HUX-3780-33) Avail: NTIS

Continuing research is briefly summarized, and a list of reports on completed projects is included. A new method of determining certain parameters of an alkali halide crystal is reported, and surfaces of all alkali halide dimers were generated. A method for phase determinations was extended to electromagnetic wave scattering. Work on the quantum mechanics of H,H2 scattering is mentioned, and transition state analysis of classical trajectories was applied to H + H2 yields H2 + H, and the reversible reaction H + HBr = H2 + Br. The differential cross section and final velocity distribution were measured for the H + H2 exchange reaction. N.E.N.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N71-16939# Lockheed Missiles and Space Co., Palo Alto, Calif.
WAVE PROPAGATION IN MEDIA WITH RANDOM INHOMOGENEITIES
S. M. Rytov [1970] 5 p Transl. into ENGLISH from the book "Vvdenie v Statisticheskuiu Radiofiziku" Moscow, Nauka, 1966 p 335-339

Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Questions are considered in which the correlation theory of random fields is applied to wave propagation in the presence of statistical inhomogeneities of the medium. Numerous phenomena are included from various branches of physics such as light scattering, radiowave scattering in the troposphere and ionosphere, fluctuation of refraction, optical and radio flickering, the phenomenon of ultralong-range USW propagation, radiowave reflection from the sea surface and from a rough land surface (radar from an aircraft, radar of the moon), and acoustic wave scattering in the sea. Author

N71-16940# Lockheed Missiles and Space Co., Palo Alto, Calif.
SHORT WAVE PROPAGATION IN A CYLINDRICAL SHELL
E. O. Ometsinskaia [1970] 6 p refs Transl. into ENGLISH from Prikl. Mekh. (Ukrainia SSR) v. 6, no. 10, 1970 p 60–65
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The applicability of nonclassical equations of cylindrical shell dynamics, obtained by using the power series method, to study of short wave processes in a shell is investigated. Dispersion relations describing the propagation of axisymmetric sinusoidal strain waves in an infinite cylindrical shell, obtained by solving expanded equations of shell dynamics using the power series method in two variants, are studied. The dispersion curves corresponding to the given dispersion relations are compared with the exact solution of the problem by three-dimensional elasticity theory. R.B.

N71-16941# Lockheed Missiles and Space Co., Palo Alto, Calif.
SCATTERING BY A STATISTICALLY ROUGH SURFACE (KIRCHHOFF METHOD)
S. M. Rytov [1970] 9 p Transl. into ENGLISH from the book "Vvdenie v Statisticheskuiu Radiofiziku" Moscow, Nauka, 1966 p 359–369
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The case of large roughness in the absence of specular reflection is considered with respect to acoustics and radio physics. The scattering of radar or sonar waves from ocean surface or bottom is discussed. For small roughness, both the Green theorem and the Rayleigh method can be utilized by applying perturbation theory, but for the case of large roughness, only the Green function remains valid. The Kirchhoff principle is also applied on the assumption of smoothness of the roughness. R.B.

N71-16985# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
STATISTICAL STUDY OF A VIDEO SIGNAL [ETUDE STATISTIQUE D'UN SIGNAL D'IMAGE]
D. Estournet Lexington, Mass. Lincoln Lab. MIT Mar. 1970 30 p refs Transl. into Onde Elec. (France), v. 49, no. 8, 1969 p 848–857 Prepared for Lincoln Lab., MIT
(AZT-70-203-FRLL) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The general outlines and a few experimental findings of statistical research on video signals are presented. The parameters chosen to define a video signal are discussed, followed by comments concerning the specific statistical measurements made: histograms of the amplitudes, the steps and the spaces given, as well as some notes on the transitions between steps. A dependence between the amplitudes and the steps and a relation between the probabilities of the spaces and those of the steps and transitions between steps are found. Author

N71-16986# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EQUIPMENT FOR OPTIMAL RECEPTION AND ANALOGUE CONVERSION OF RADAR SIGNALS REFLECTED FROM CLOUDS AND PRECIPITATIONS [USTROYSTVO DLYA OPTIMALNOGO PRIYEMA I ANALOGOVYKH PREOBRAZOVANIY RADIOLOKATSIONNYKH SIGNALOV, OTRAZHENNYKH OT OBLAKOV I OSADKOV]
N. V. Gornostayev et al May 1970 21 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 231, 1968 p 63–74
(D-3)-70-03) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A functional circuit for a new weather radar receiver is described that uses sawtooth voltage with high linearity at a recurrence cycle corresponding to the frequency of transmission from the station. The circuit is constructed by successive combinations of signals with cathode detection and guarantees high stability and accuracy of the logarithmic frequency response characteristics by deep negative feedback in intermediate frequency amplifier cascades and cascade repeaters. G.G.

N71-17015# Admiralty Research Lab., Teddington (England).
GENERAL TREATMENT OF MODULATION SCANNING
G. M. Voglis Feb. 1970 49 p refs
(AD-713278; ARL/H/R3; NSTIC/27406(8)) Copyright. Avail: NTIS CSCL 17/1

The basic principles of scanning sonars employing modulation scanning are described. Using elementary matrix theory a number of methods involving frequency change are evolved including a multistage system of particular relevance to rapid scanning of fine beams over wide sectors. Phasing requirements and limitations due to carrier frequency are examined. Author (GRA)

N71-17037# Stanford Univ., Calif. Center for Radar Astronomy.
ESTIMATION OF POLARIZATION WITH ARBITRARY ANTENNAS
G. Leonard Tyler Oct. 1970 29 p refs
(Grant NGR-05-020-348)
(NASA-CR-116449; SU-SEL-70-064; SU-SR-3610-1) Avail: NTIS CSCL 09E

The problem of polarization measurement is considered under the assumption that observations are carried out using unknown antennas and a variety of calibration signals. The explicit effects of antenna parameters on observations of the coherency matrix of the received waves is determined. A simple method for determining percentage polarization is discussed. The results have been applied to the reduction of bistatic-radar observations of the moon. Author

N71-17070# AEG-Telefunken, Backnang (West Germany). Fachbereich Anlagen Weitverkehr und Kabeltechnik.
COMBINED 4 DEG/10.8 DEG ANTENNA FOR COMMUNICATION SATELLITES [KOMBINIERTE 4 DEG/10,8 DEG-SATELLITEN-BORDANTENNE]
M. Uhlmann and H. D. Kuehne Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1970 187 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-42) Avail: NTIS; ZLDI Munich: 38,65 DM

Different on-board SYMPHONIE satellite antenna configurations were examined. The required double-beam characteristics can be realized either with an antenna array or with reflector antennas and in both cases a single or two separate radiation apertures can be used. These different concepts are analyzed taking account of an eventual beam tilt. Author (ESRO)

N71-17120# General Electric Co., Philadelphia, Pa. Missiles and Space Div.
ORBIT/SPECTRUM UTILIZATION STUDY. VOLUME 3.

BOOK 1: ECONOMICS CONSIDERATIONS
D. A. Kane and M. C. Jeruchim 30 Jun. 1970 360 p refs
(Contract OEP-SE-69-102)
(PB-194782; Doc-70SD4246-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 17B

The technical and cost factors associated with communications systems utilizing satellites in geostationary orbit are described for the development of a methodology to permit efficient utilization of the geostationary orbit space and the frequency spectrum. Cost versus performance relations for telephony, TV distribution, and TV broadcast systems are developed for applying costs to the orbit spacing technical criteria. Cost versus performance relations are developed for the significant variable-cost items of a communications system, including both ground and space segment. A computerized analytical model was developed to permit synthesis of various combinations of the services and their associated technical parameters, and to determine the system costs. Trade studies are built-in to permit reduction of the input variables to the computer program. Author (GRA)

N71-17126*# Research Triangle Inst., Durham, N.C.
STATISTICAL ANALYSES OF RAM-C X-BAND SIGNAL STRENGTH DATA Final Report
Dec. 1970 213 p refs
(Contract NAS1-8837)
(NASA-CR-111810) Avail: NTIS CSCL 20C

Results are presented of analyses of the pulse-by-pulse return signal from the onboard X-band telemetry system in the RAM C-1 and C-2 payloads. The data as originally recorded contained system errors and nonstationarities caused by slant range variation and antenna pattern modulation. The system errors and range variations were removed and various analytical techniques were applied to the data to examine the effect of ionization on the signal level and the effect of material injection on the recovery of both signal level and the antenna pattern signature. Signal strength data are presented for both missions in three different formats: 1) edited signal strength peak detected over a 200 millisecond period, 2) edited signal strength data on an expanded (millisecond) time base, and 3) edited signal strength data using a sliding averaging technique to smooth the data. Author

N71-17368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STADAN-NASCOM SUPPORT FOR THE SERT 2 MISSION
Martin J. Conroy Washington Feb. 1971 19 p
(NASA-TM-X-2178; E-5897) Avail: NTIS CSCL 17B

This report describes the command and telemetry links between the SERT II spacecraft and the tracking stations of the Space Tracking and Data Acquisition Network (STADAN). The data transmission via the NASA Communications Network (NASCOM) from the tracking stations to the Spacecraft Control Center at Lewis is also described. The criteria for selection of the tracking stations are given, along with a description of the sets of tests performed with the stations, and on the spacecraft. A brief summary of the on-orbit operations concludes the report. Author

N71-17466*# National Aeronautics and Space Administration, Washington, D.C.
BROADCASTING BY MEANS OF SATELLITES
N. I. Chistyakov Feb. 1971 51 p Transl. into ENGLISH of the book "Radioveshchaniye Cherez Sputniki" Moscow, Znaniye Press; 1969 p 3-47
(NASA-TT-F-628) Avail: NTIS CSCL 17B

The principles involved in the construction of a satellite broadcasting network are discussed; the differences and advantages as well as shortcomings of elliptical and circular orbits, both equatorial and inclined to the plane of the equator, are outlined. The differences between passive and active communications satellites are pointed out and factors which complicate the use of satellites for international radio and television broadcasting are discussed (differences in language, time, broadcasting standards, and population distribution). Author

N71-17582*# Hughes Aircraft Co., Culver City, Calif.
PARAMETRIC ANALYSIS OF MICROWAVE AND LASER SYSTEMS FOR COMMUNICATION AND TRACKING. VOLUME 4: OPERATIONAL ENVIRONMENT AND SYSTEM IMPLEMENTATION
Washington NASA Feb. 1971 218 p refs
(Contract NAS5-9637)
(NASA-CR-1689) Avail: NTIS CSCL 17B

A major study was undertaken to make a comparative analysis of microwave and laser space telecommunication systems. A portion of the study is reported and includes the following: (1) Research was conducted on background radiation and atmospheric propagation dealing with interfering signals that compete with both laser and microwave communication. The atmospheric attenuation is given as a function of frequency and weather condition. (2) An investigation of ground receiving facilities was made and a brief description of current world wide tracking networks is given. (3) The results of a study on system implementation are presented in which the communication systems of several successful spacecraft are described. D.L.G.

N71-17612*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-66, VOLUME 2 FOR THE PERIOD 1 SEPTEMBER-31 OCTOBER 1970. THE DEEP SPACE NETWORK
30 Nov. 1970 168 p refs
(Contract NAS7-100)
(NASA-CR-116517; JPL-SPS-37-66-Vol-2) Copyright. Avail: NTIS CSCL 22A

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5. COMMUNICATIONS ELEMENTS RESEARCH p 49-69 refs (See N71-17617 07-07)
6. SUPPORTING RESEARCH AND TECHNOLOGY p 70-89 (See N71-17618 07-09)
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13. FACILITY ENGINEERING p 154-160 (See N71-17625 07-11)

N71-17613*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESCRIPTION OF THE DSN
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space

Network 30 Nov. 1970 p 1-3 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 22A

The operational support provided by the Deep Space Network (DSN) is discussed. The DSN operation is characterized by six DSN systems: (1) tracking, (2) telemetry, (3) command, (4) monitoring, (5) simulation, and (6) operations control. The Network consists of the Deep Space Instrumentation Facility (DSIF), the Ground Communications Facility (GCF), and the Space Flight Operations Facility (SFOF). R.B.

N71-17614*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTERPLANETARY FLIGHT PROJECTS
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 4-11 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 22A

The major events of DSN support of the active interplanetary Pioneer spacecraft during 1970 are reported. The planetary support planning activities for the Pioneer 6 and 7 missions for closeup reconnaissance of Jupiter are summarized. Author

N71-17615*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND NAVIGATIONAL ACCURACY ANALYSIS
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 12-26 refs (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 17G

Research progress is reported on a project to determine the inherent accuracy of the DSN as a radio navigation instrument for lunar and planetary missions. The use of sequential estimation with process noise for processing DSN tracking data during planetary orbiter missions and Doppler determinations of polar motion using satellites are discussed. R.B.

N71-17616*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 27-48 refs (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 17B

Research on communications systems is reported, including group delay measurements of Block 3C receiver-exciter modules, integrated circuit packaging systems, estimating the parameter of an exponential distribution using quantiles, DSIF integrated circuit layout and isoperimetric problems, and an asymptotic formula for the mean cycle-slip time of a second order phase-locked loop with frequency offset. R.B.

N71-17617*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS ELEMENTS RESEARCH
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 49-69 refs (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 17B

Research progress is reported on communications elements for the Deep Space Network, including low-noise microwave maser receivers, RF properties of 210-ft-diam antenna mesh material, system operating noise temperature calibrations of low noise cones, polarization diversity S-band cone waveguide/polarimeter calibrations, high power feed components, and S-band polar ultra cone improvement. R.B.

N71-17622*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN PROJECTS AND SYSTEMS DEVELOPMENT
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 141-145 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 22A

A code for automated reporting of DSN status to DSN management and to the individual flight project is discussed. The user requirements forecast for the DSN is also considered. R.B.

N71-17623*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN OPERATIONS
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 146-150 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 22A

The operations of the DSN command system are described. Command system data are generated at the Space Flight Operations Facility, transmitted via high-speed data lines by the Ground Communications Facility, and received by the telemetry and command process or at the Deep Space Station. System status and alarm information are returned via the same high-speed data lines. Author

N71-17624*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF OPERATIONS
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 151-153 refs (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 14B

Radio science support by the Deep Space Instrumentation Facility is described. Operations include a test of general relativity by very long baseline interferometer techniques and a pulsar polarization study. R.B.

N71-17639 Denver Univ., Colo.
EXPANDING THE CAPABILITY OF SEQUENTIAL DECODING FOR DEEP SPACE COMMUNICATIONS
Harvey Mark Gates (Ph.D. Thesis) 1969 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-1924

Convolutional encoding is well adapted to the application of error control and/or data compression using maximum likelihood and maximum a posteriori probability decoders. These codes are sequentially decoding using the Fano algorithm and in the case of redundant source data, using the a posteriori probability of the source data. The hypothetical performance of a channel using convolutional codes is given as well as methods for collecting source data. Two channel models were implemented on a general purpose computer to demonstrate the feasibility of the concepts. The models include the implementation of an encoder, channel, and decoder, and are given in the form of system block diagrams and logic flow charts. Dissert. Abstr.

N71-17706 Denver Univ., Colo.
REFLECTION OF TRANSIENT VLF SIGNALS FROM A STRATIFIED MAGNETO-IONIC MODEL OF THE IONOSPHERE
Robert Higley Reck (Ph.D. Thesis) 1969 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 70-1920

A method is presented for calculating the first hop skywave of a VLF transient signal at a short distance from the source using the recorded groundwave and a stratified model of the inhomogeneous anisotropic ionosphere. The earth's magnetic field is included in the analysis. Waveforms calculated assuming the ionospheric profiles of other investigators are compared to one skywave recorded 200 km from the source. A D-region electron density profile is determined by synthesis of the recorded skywave. A lower bound for the collision frequency at 70 km is determined. The analysis shows that reflection occurs mainly from a quasi-isotropic region of the ionosphere. The ionospheric profiles determined by the synthesis procedure are compared to those of other investigators. Dissert. Abstr.

N71-17707*# Stanford Univ., Calif. Center for Radar Astronomy.
THE DESIGN AND DEVELOPMENT OF A LOW-COST MICROWAVE ADAPTOR SUITABLE FOR TELEVISION RECEPTION FROM HIGH-POWER COMMUNICATIONS SATELLITES Final Report
B. B. Lusignan, P. Z. Bulkeley, J. M. Janky, and R. B. Taggart, Jr.
31 Oct. 1970 196 p refs
(Contract NAS12-690)
(NASA-CR-72773; SU-SEL-70-075) Avail: NTIS CSCL 17B

The design is presented of a mass-producible microwave adaptor which is capable of detecting wideband FM television signals broadcast from a synchronous satellite. A complete communications system design at 2.62 GHz is included. Performance criteria are formulated, and the appropriate alternatives are evaluated. A novel design for the antenna is presented, which is estimated to cost $32 in quantities of 100,000 units. The electronics package is estimated to cost $60 for the same production quantity. The design details of working prototypes of both the antenna and electronics package are included. The trends for higher frequencies are discussed, and a design for a 12 GHz system is discussed. Author

N71-17742# Naval Research Lab., Washington, D.C. Search Radar Branch.
STATISTICAL TIME-VARYING AND DISTRIBUTION PROPERTIES OF HIGH-RESOLUTION RADAR SEA ECHO
K. R. Schmidt Nov. 1970 33 p refs
(AD-714836; NRL-7150) Avail: NTIS CSCL 17/9

An analysis was made of airborne, X-band, high-resolution radar data taken under conditions of low grazing angle and a moderately rough sea. The two principal areas which have been investigated are: (a) the possible temporal nonstationarity of the radar data, and (b) the use of the chi-square family of distributions as a possible fit to the first-order probability distribution of the data. In the first area it was found that, for a 2-min period, the upwind data appeared to be the most random (i.e., stationary) for both vertical and horizontal polarizations, with the time trends in the other cases being relatively minor. In the second area it was found that an excellent fit for vertical polarization is obtained by using the chi-square distribution, where the mean and variance of the data are matched to that of the theoretical distribution. Author (GRA)

N71-17764# Naval Underwater Systems Center, New London, Conn.
ELECTRIC FIELD PRODUCED BY A LONG, HORIZONTAL ELECTRIC LINE SOURCE ABOVE AN INHOMOGENEOUS SURFACE
Dennis E. Fessenden 25 Aug. 1970 22 p refs
(AD-714791; NUSC/NL-3007) Avail: NTIS CSCL 20/14

An approximate perturbation technique is used to derive expressions for the near and far electric fields produced by a horizontal electric line source above a periodically inhomogeneous surface. The periodically inhomogeneous surface might simulate, in a rather crude manner, a sinusoidal type of ocean surface. Author (GRA)

N71-17793# Naval Research Lab., Washington, D.C.
A FORTRAN SUBROUTINE TO DECODE TAPE-RECORDED DIGITAL DATA FROM THE RANDLE CLIFF RADAR
Frank D. Clarke Nov. 1970 31 p
(AD-715336; NRL-MR-2180) Avail: NTIS CSCL 17/9

A Fortran subroutine, EXEVAL, has been written to operate on the CDC 3800 computer. The subroutine will permit data extraction from magnetic tapes recorded from the Randle Cliff Radar (RCR) data acquisition system at CBD. While the subroutine is written to accommodate a current specific RCR recording format, it can be easily adapted to any desired format. Subroutine EXEVAL operates on a record-by-record basis and optionally provides a new tape on which the extracted data are recorded. Author (GRA)

N71-17853# Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
LIFE CYCLE COST STUDY (COST OF OWNERSHIP REPORT) FOR AN/PPS-18 (XN-1) ULTRA RELIABLE RADAR
15 Nov. 1970 53 p
(Contract N00039-70-C-3502)
(AD-715064) Avail: NTIS CSCL 17/9

The primary objective of the cost study was to compare cost of the new design concept of the AN/PPS-18 (XN-1) with the existing AN/PPS-6. An additional goal was to study various overhaul policies to determine the least cost maintenance policy for the new design. Author (GRA)

N71-17855# Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
AN/PPS-18 (XN-1) ULTRA RELIABLE RADAR Interim Development Report, 1 – 31 Oct. 1970
J. D. Frattura 9 Nov. 1970 14 p refs
(Contract N00039-70-C-3502)
(AD-715063; IDR-9) Avail: NTIS CSCL 17/9

The program covers the study, design, construction, test analysis and inspection of a complete and operative, highly reliable, relative failure-free version of the pulsed doppler surveillance AN/PPS-6 radar set. The radar set is intended to be a lightweight, miniaturized, X-band, pulse doppler combat surveillance radar. Author (GRA)

N71-17866*# Auburn Univ., Ala. Microwave Research Lab.
A SYSTEM FOR MEASURING THE FREQUENCY STABILITY OF AN FM TV TRANSMITTER Quarterly Technical Report
M. A. Honnell Sep. 1970 73 p refs
(Contract NAS8-26193)
(NASA-CR-103030; QTR-1) Avail: NTIS CSCL 17B

The design and construction of a system for measuring the frequency stability of an S-band, FM TV transmitter are described. The theory of a phase lock loop relevant to the design of the frequency measurement system is discussed with emphasis on the design equations. The design of each unit of the physical system is then presented along with the design considerations involved in the choice of system components. The tests performed on the system are discussed along with a comparison between test results and calculated performance. The results of a satisfactory measurement of the frequency of an S-band FM television transmitter are presented. Author

N71-17867*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SERT 2 COMMUNICATIONS SYSTEM DESIGN
Robert J. Zakrajsek and Edward J. Domino Washington Mar. 1971 37 p ref
(NASA-TM-X-2189; E-5963) Avail: NTIS CSCL 17B

The SERT 2 communications system is composed of a PCM-FM-PM telemetry downlink and a multitone-AM command uplink. Design calculations are included in the following areas: error analysis, bandwidth calculations, RF link calculations, and antenna system design. The systems' configuration is described which includes the system type and function, signal flow, and the spaceborne-ground compatibility requirements. The component descriptions include the type, function, specifications, and compatibility requirements where necessary. Also described in this report is the unique type of verify system which permits verification of a command, via telemetry, prior to its execution. Author

N71-17946# Institute for Telecommunication Sciences, Boulder, Colo.
EXHAUSTIVE SEARCH FOR THE BEST CYCLIC (20, 8) CODE
L. R. Espeland and M. Nesenbergs Apr. 1970 30 p refs
(ESSA-TR-ERL-174-ITS-111) Avail: SOD $0.35

An exhaustive computer search for the best, simply implemented, cyclic (20, 8) codes was carried out, and the procedures and results are reported here. Some forty almost equally good (20, 8) codes are identified but none of them appear to be better than the familiar (15, 5) Bose–Chaudhuri–Hocquenghem code. Author

N71-17947# Institute for Telecommunication Sciences, Boulder, Colo.

A TWO-SIGNAL PRIMER FOR FOURIER ANALYSIS OF A RANDOM ACCESS COMMUNICATION SYSTEM

M. Nesenbergs Jul. 1970 31 p refs

(ESSA-TR-ERL-178-ITS-113) Avail: SOD $0.40

The detectability parameter, i.e., the acquisition signal-to-noise ratio, is derived for an elementary two-signal multiple access channel. The basic Fourier series approach requires no approximations, and the methodology may be used in a rigorous analysis of a more realistic random access satellite repeater. Author

N71-18013# Lehigh Univ., Bethlehem, Pa. Dept. of Electrical Engineering.

CHARACTERIZATION AND MODELING OF REAL COMMUNICATION CHANNELS

Jean-Pierre Adoul, Bruce D. Fritchman, and Laveen N. Kanal (Maryland Univ., College Park) 31 Jul. 1970 129 p refs

(Grant AF-AFOSR-1390-68)

(AD-715288; AFOSR-70-2610TR) Avail: NTIS CSCL 9/4

The paper presents new descriptive and generative models for the error-cluster and error gap patterns which occur in the binary, discrete-time stochastic processes observed as outputs of digital communication channels having memory. The slope of the error-gap distribution is used to uncover relationships between various channel models. One characterizes the memory mu of a process of error density Pe by its relative deviation in average conditional entropy from the discrete memoryless channel (D.M.C.), which one proves has maximum entropy for the class of (finite and infinite memory length) processes of density Pe. One obtains an upper bound for mu for real channels, derive mu for the general discrete renewal process from the error gap probability mass function (EGPMF) and prove that it is a lower bound for any processes having the same EGPMF. One demonstrates some limitations of finite error-free state models by showing that their EGPMF is bounded from above by a geometric series. To estimate the counting distribution with flexibility we introduce conditional gap distributions and multigap statistics. One uses these in implementing a denumerable Markov Chain model which, free from finite state model limitations and more general than renewal processes, allows the derivation of all classical statistics including entropy. Author (GRA)

N71-18098# Radio Technical Commission for Aeronautics, Washington, D.C.

MINIMUM PERFORMANCE STANDARDS: AIRBORNE RADIO MARKER RECEIVING EQUIPMENT OPERATING ON 75 MEGAHERTZ

8 Jan. 1970 44 p Supersedes Paper 87-54/DO-57A

(DO-143) Avail: NTIS; RTCA Secretariat, Suite 302, 2000 K St., N.W., Washington, D.C.: $3.00

The minimum performance standards for airborne radio marker receiving equipment are presented. Standard test conditions and methods are also recommended. Author

N71-18108# Radio Technical Commission for Aeronautics, Washington, D.C.

MINIMUM PERFORMANCE STANDARDS: AIRBORNE RADIO RECEIVING AND DIRECTION FINDING EQUIPMENT OPERATING WITHIN THE RADIO FREQUENCY RANGE OF 200-850 KILOHERTZ

8 Jan. 1970 70 p Supersedes RTCA-158-61-/DO-111

(DO-142; RTCA-158-61/DO-111) Avail: NTIS

The performance standards presented are intended to provide a means of assurance that the equipment will perform its intended function under all conditions, including IFR, normally encountered in routine aeronautical operations. In order to accomplish this, the specifications are arranged under the following headings: (1) general standards, (2) minimum performance standards under standard operating conditions, and (3) minimum performance standards under environmental test conditions. Recommendations for methods for measurement, standard test conditions, and methods of test are included. D.L.G.

N71-18109# Radio Technical Commission for Aeronautics, Washington, D.C.

MINIMUM OPERATIONAL CHARACTERISTICS FOR AIRBORNE ATC TRANSPONDER SYSTEMS

12 Mar. 1970 56 p refs

(DO-144) Avail: NTIS

The requirements of basic characteristics for navigation and communication systems used in air traffic control are discussed. Equipment specifications, and environmental and international standards are presented. R.B.

N71-18111# Wheeler Labs., Inc., Smithtown, N.Y.

DEVELOPMENT AND DEMONSTRATION OF W-LINE COMMUNICATIONS WAVEGUIDE SYSTEM Final Report

Irwin Koffman, Richard A. Lodwig, Henry W. Redlien, and Harold A. Wheeler Apr. 1970 74 p refs

(Contract DOT-FR-90022)

(PB-191028; WL1611A) Avail: NTIS

The feasibility of using a continuous-access VHF waveguide for providing nonradiating communications with a high-speed vehicle on a track was demonstrated. The waveguide is an open-sided TEM-mode transmission line coupled to the vehicle by a noncontacting directional coupler. The attentuation, bandwidth, transmission distortion, and mechanical stability of the waveguide assembly are reported. The cost for materials and fabrication is estimated at $10,000 per mile. F.O.S.

N71-18116# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.

SURVEY OF AIR TRAFFIC CONTROL RADAR BEACON SYSTEM OPERATIONAL PROBLEMS (30 DAY ATC CONTROLLER SURVEY)

Kenneth Wise Jan. 1970 50 p

Avail: NTIS

The survey results presented include the significant findings of over 12,000 individual trouble reports received from air traffic controllers at beacon sites. The reports were collected from civil and military towers and centers and include problems connected with ground equipment as well as those of the aircraft. D.L.G.

N71-18128*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

A SURVEY ON SOME MATHEMATICAL MODELS OF THE VERY LOW FREQUENCY WAVE PROPAGATION

David H. S. Cheng (Missouri Univ.) Dec. 1970 43 p refs

(NASA-TM-X-65448; X-521-70-425) Avail: NTIS CSCL 17B

Four mathematical models used in the study of VLF wave propagation are examined in detail and the limitations of each are demonstrated. These models include the waveguide mode theory, the zonal harmonic series, the eigenfunction method, and the full wave theory. It is concluded from the examination that the current theories of VLF propagation are incapable of explaining: (1) the diurnal and the seasonal variations of the long distance VLF field; (2) the dependence of both the field intensity and the phase on a heterogenous path of various illuminations; and (3) the effect of the solar flare on both the field strength and the phase. D.L.G.

N71-18130# Institute for Telecommunication Sciences, Boulder, Colo.
MODULATION STUDIES FOR IGOSS
Hiroshi Akima Jun. 1970 56 p refs
(ESSA-TR-ERL-172-ITS-110) Avail: SOD $0.55 CSCL 17B

Modulation techniques for high frequency data transmission for the Integrated Global Ocean Station System (IGOSS) are discussed. Noncoherent frequency-shift-keying (NCFSK) and time-differential phase-shift-keying (TDPSK) systems are preliminarily selected as preferred systems. Performances of these preferred systems are discussed both in the presence of noise and/or interfering signal and under adverse propagation conditions. A serious drawback inherent in a TDPSK system under adverse propagation conditions is pointed out. Frequency tolerance, frequency stabilization techniques, and selectivity of receivers are also discussed. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N71-16976# Joint Publications Research Service, Washington, D.C.
THEOREM OF CODING STATEMENTS IN ARBITRARY LANGUAGES
V. S. Proskurov *In its* Cybernetics and Regulation Theory 14 Dec. 1970 p 13-18 refs (See N71-16973 07-10)
Avail: NTIS

Various rules for coding the words of a dictionary consisting of N words are discussed, the basic one of which is the operation of convolution of the codes of the words containing l sub i letters to codes containing k letters. In theorem 2 of the given reference it is proved that the convolution is ambiguous coding with the probability of violation of uniqueness approaching zero when k approaches l = max (l sub i). Coding becomes unique only when k = l = max (l sub i). The convolution does not permit determination of the initial word by the code of length k. The theorem is proved of how one-to-one coding exists which permits any statement to be represented by a code of any length given in advance (for example, k = 1) by which it is possible to reproduce the initial statement. Author

N71-16977# Joint Publications Research Service, Washington, D.C.
CARRYING CAPACITIES OF INFORMATION SYSTEMS WITH FEEDBACK AND INTERNAL NOISE
V. V. Petrov et al *In its* Cybernetics and Regulation Theory 14 Dec. 1970 p 19-22 refs (See N71-16973 07-10)
Avail: NTIS

The relation of the Shannon concepts to the results of Kolmogorov-Wiener is demonstrated. The carrying capacity defined by the Shannon formula with arbitrary Gaussian processes (signal and noise) corresponds to the optimal characteristic obtained on the basis of the criterion of the least mean square random error without considering the condition of physical realizability. This characteristic is limiting from the point of view of the least mean square error, and deviation from it permits a physically realizable filter. A comparatively simple algorithm is proposed for finding the limiting characteristics and the carrying capacities of the dynamic systems with feedback and internal noise corresponding to them. Author

N71-17071# National Physical Lab., Teddington (England). Central Computer Unit.
SOME STATISTICS FROM ALGOL PROGRAMS
B. A. Wichmann Aug. 1970 64 p refs
(NPL-CCU-11) Copyright. Avail: NTIS

The NPL studies involved the monitoring of 155 million instructions and the resulting data can be used by compiler-writers in deciding which features of a compiler are worth optimizing. Statistics are also given of the occurrence of basic symbols in source text and of instructions in compiled programs. From the execution statistics, an ALGOL mix was devised and run on 18 ALGOL systems so indicating their weaknesses and merits, and comparing their execution speeds. Author (ESRO)

N71-17072# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
A NUMERICALLY STABLE FORM OF THE SIMPLEX ALGORITHM
P. E. Gill and W. Murray Aug. 1970 44 p refs
(NPL-Ma-87) Copyright. Avail: NTIS

The Simplex method is subject to computational instabilities so a numerically stable form was obtained with storage requirements and computational efficiency comparable with those of the standard form. The method admits non-Simplex steps and this feature enables it to be readily generalized to quadratic and nonlinear programming. The necessary modification formulas are given for extensions to constraints having a large number of non-zero elements. Author (ESRO)

N71-17090# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MACHINE GRAPHICS [MASHINNAYA GRAFIKA]
Yu. M. Bayakovskiy et al May 1970 35 p refs Transl. into ENGLISH of Russian report VKP-2
((D-1)-70-01; VKP-2) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A survey is given of the functional potentialities of electronic computers which are possible in present day graphic equipment. The greatest attention is paid to the overall design, operating principles and basic functional potentialities of display consoles with cathode-ray tubes. Several questions involved in the programming of graphic systems are discussed. Author

N71-17133# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
ALGOL PROGRAMMES FOR THE RESPONSE ANALYSIS OF LINEAR SYSTEMS WITH DETERMINISTIC OR RANDOM INPUTS
L. J. Hazlewood and E. Huntley London Aeron. Res. Council 1970 74 p refs Supersedes RAE-TR-69140; ARC-31816
(ARC-CP-1124; RAE-TR-69140; ARC-31816) Copyright. Avail: NTIS; HMSO: £ 1; BIS: $3.60

Computer programs for the output functions of systems defined by time-invariant ordinary differential equations are given. The programs are described primarily for users and the use of prepared data sheets is demonstrated. Author (ESRO)

N71-17163# California Univ., Berkeley. Lawrence Radiation Lab.
A REVIEW OF THE MAJOR PROBLEMS ENCOUNTERED DURING TEN YEARS OF OPERATING A LARGE SCIENTIFIC COMPUTING SYSTEM
Carol F. Osborne 22 Jul. 1970 6 p refs Presented at the Conf. on Automation of Sci. Res. on the Computer Base, Novosibirsk, USSR, 14-18 Sep. 1970; sponsored by Computing Center and the Inst. of Automation and Electrometry of the Siberian Dept. of the Acad. of Sci. of the USSR
(Contract W-7405-eng-48)
(UCRL-19842; CONF-700917-1) Avail: NTIS

The characteristics of an automatic film scanning device attached on-line to an IBM 7094 II computer are discussed. The

system monitor is multiprogrammed to coordinate computer use between three levels of priority: 1) realtime automatic scanning of bubble chamber film, 2) processing of the scanned data, and 3) batch processing of other analysis programs. Bubble chamber events are processed, completely automatically, at the rate of 150 per hour. Operational problems encountered in growing to 500,000 events per year are discussed. These can be categorized as follows: 1) people and machine problems in manual (or semi-automatic) scanning, 2) maintaining communications between operating staff and programmers, 3) restart and recovery procedures, 4) quality control, 5) hardware problems, 6) time and event accounting procedures, and 7) data summarization. Author (NSA)

N71-17185# European Space Research and Technology Center, Noordwijk (Netherlands).
AUTOMATIC DERIVATION OF THE RIEMANN TENSOR IN AN N-DIMENSIONAL SPACE USING FORMAC/PL1 [DERIVATION AUTOMATIQUE DU TENSEUR DE RIEMANN DANS UN ESPACE A N DIMENSIONS A L'AIDE DU FORMAC PL1]
Francesco A. Brunacci Paris ESRO Jun. 1970 40 p refs In FRENCH; ENGLISH summary
(ESRO-TM-151-ESTEC) Avail: NTIS

On the basis of formulas giving the Cartesian coordinates in an N-dimensional space as functions of general coordinates in an M-dimensional manifold (M less than or equal to N), a system of programs was developed in FORMAC/PL1. These programs make it possible to calculate the covariant and contravariant components of the fundamental tensor, the Christoffel symbols of the first and second kinds and the Riemann tensor. A listing of a recent version of these programs is included; the formulas used are reviewed and some examples of results are presented. Author (ESRO)

N71-17343*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOSTAR-2: A GEOPOTENTIAL AND STATION POSITION RECOVERY SYSTEM
C. E. Velez and G. P. Brodsky Oct. 1970 118 p refs
(NASA-TM-X-65441; X-553-70-372) Avail: NTIS CSCL 09B

The GEOSTAR-2 multiple arc geopotential coefficient and station position recovery system is described. This system was developed using the GEOSTAR-1 system as a base, and is the second in a series of geodetic programs under current development and use by the Mission and Trajectory Analysis Division. Author

N71-17411*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC DATA ANALYSIS TECHNIQUES USED IN THE LANGLEY TIMES SERIES ANALYSIS COMPUTER PROGRAM
Robert C. Ward Washington Feb. 1971 75 p refs
(NASA-TM-X-2160; L-7360) Avail: NTIS CSCL 09B

A reference guide to users of the Langley time series analysis computer program, which a general purpose program for the analysis of random, stationary time series, is presented. The bases for choosing available options, descriptions of the options, possible output quantities, equations of the various computations, and tables and figures which might aid in the analysis of data are included. Author

N71-17485*# Philco-Ford Corp., Palo Alto, Calif. Space and Reentry Systems Div.
USER'S MANUAL FOR THE MARK 4 ERROR PROPAGATION PROGRAM
Dec. 1969 140 p refs
(Contract NAS1-9307)
(NASA-CR-111852; TR-DA2154) Avail: NTIS CSCL 09B

The Mark 4 Error Propagation Program is a computer program which enables the study of parameter interrelationships in the realms of lunar or interplanetary trajectories, navigation and guidance; it is a fourth-generation program. The Mark 4 program is a version of the Mark 2 Error Propagation Program converted for operation in Fortran 4 on the CDC 6600 computer and modified by the addition of start-up and search capabilities. The Mark 2 program, delivered in December 1965, was written partly in Fortran 4 and partly in machine language (MAP) for the IBM 7094 computer. It lacked the start-up and generalized search capabilities, presuming the initial trajectory conditions to be obtained from some other program. A restricted search capability for integrated trajectories was available in the Mark 2 program, however. The Mark 4 program retains all of the capability of the Mark 2 program, is generally more efficient, and has been simplified in its programming. Author

N71-17755# Monsanto Research Corp., Dayton, Ohio.
SUSCEPTIBILITY OF POLYURETHANE FOAM TO DETERIORATION BY IMPURITIES OR CONTAMINANTS IN ETHYLENE GLYCOL MONOMETHYL ETHER Technical Report, 1 Aug. 1969 - 15 Sep. 1970
William G. Scribner and Gregory W. Gandee (AFAPL) Wright-Patterson AFB, Ohio AFAPL Oct. 1970 33 p refs
(Contract F33615-69-C-1325)
(AD-715313; MRC-DA-269; AFAPL-TR-70-76) Avail: NTIS CSCL 11/9

Polyurethane foam used to suppress fire and explosion in the fuel tanks of certain aircraft normally possesses excellent storage stability in ethylene glycol monomethyl ether (EGME) and water mixtures such as would be found in fuel tank water bottoms. However, certain lots of EGME were found to cause severe degradation of foam after one week of storage at 160F in 25% EGME-75% water. A major supplier of EGME traced the cause of foam degradation to the presence of lead and/or tin at the ppm level in EGME, a condition resulting from the storage of EGME in one-gallon cans with soldered seams. Data are presented which confirm the lead ion as the cause of foam degradation and which demonstrate that certain other metal ions at the ppm level did not produce the degradation effect under the solution conditions tested. It is recommended that foam stability be studied employing typical water bottoms obtained from the field. A mechanism for metal ion-catalyzed foam degradation via hydrolysis is suggested. Author (GRA)

N71-18011# TRW Systems Group, Redondo Beach, Calif.
SYSTEMS SIMULATION STUDIES. HIGH-SPEED GROUND TRANSPORTATION SYSTEMS ENGINEERING STUDY Final Report
Dec. 1969 229 p refs
(Contract C-353-66(NEG))
(FRA-RT-70-34; TRW-06816-W002-R0-00) Avail: NTIS

A computer program developed to simulate the operation of a high speed ground transportation mode within the U.S. Northeast Corridor is described. The program utilizes the TRANSIM user language for the simulation in conjunction with an output processor program written specifically to improve the basic TRANSIM output format. This conversion allows quicker accessibility to critical analysis variables. As a demonstration of the program, a simulation was performed of a 150-mph new rail facility within the Northeast Corridor. The results of this simulation and the documentation of the program are included. Author

N71-18012# Air Force Systems Command, Wright-Patterson AFB, Ohio. Avionics Lab.
VERSATILE FORTRAN 4 COMPUTER PROGRAM FOR PRODUCING CARTESIAN PLOTS SUITABLE FOR PUBLICATION USING THE CALCOMP PLOTTER
Millard G. Mier Jun. 1970 18 p
(AD-715279; AFAL-TR-70-66) Avail: NTIS CSCL 9/2

A flexible, card-input, Fortran 4 computer program has been written for the CalComp Plotter, Model 765. The output line drawing meets standards for publication. Four types of lines may be drawn through input data points: (1) no line, (2) least-squares linear-fit line, (3) smooth (spline) fit to data points, and (4) adjacent points connected by a straight line. Only Cartesian plots are possible. The size of the plot is limited only by the capability of the plotter used. Author (GRA)

N71-18058*# Michigan Univ., Ann Arbor. Radio Astronomy Observation.

OGO-3 DATA REDUCTION. OGO-2 AND 4 DATA ANALYSIS Final Technical Report, 30 Sep. 1967 -15 Aug. 1968

Fred T. Haddock Jan. 1971 8 p refs

(Grant NGR-23-005-371)

(NASA-CR-116424; UM/RAO-71-2) Avail: NTIS CSCL 09B

The OGO 3 radio astronomy experiment data processing was completed for all data received to date. The OGO 2 and OGO 4 data reduction and analysis effort was completed to the fullest extent possible. Radio-frequency interference within the spacecraft external to the experiment makes the interpretation of the radiometer data difficult, and it appears impractical to extract mapping information from OGO 4 and impossible from the spinning OGO 2. The antenna impedance measurements were not affected by the interference and represent useful data for the study of the properties of the ionosphere, and the behavior of antennas in plasma. Author

N71-18110# Harza Engineering Co., Chicago, Ill.

A COMPUTER PROGRAM FOR ESTIMATING COSTS OF HARD ROCK TUNNELLING (COHART) Final Report

Frank T. Wheby and Edward M. Cikanek May 1970 269 p

(Contract DOT-FR-9-00003)

(PB-193272) Avail: NTIS

The program described is based on construction methods, work forces, and equipment selections corresponding to the current state of the art of tunnelling. The program contains logic to permit cost estimates of complicated tunnel-shaft systems. In any estimate, the program accommodates a large number of values or changes in the values of the factors that affect costs, such as tunnel shape and size, shaft depth, rock characteristics, and construction method. To provide great flexibility, the user of the program is provided with the option of selecting lining type and thickness, profit and overhead margins, and other input data. Suggestions for selecting an appropriate value for these inputs are given. Complete operating instructions and an illustrative example are presented. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N71-17147# Standard Electrik Lorenz A. G., Stuttgart (West Germany). Zentrallabor.

TANTALUM THIN FILM CIRCUITS FOR SPACE FLIGHT APPLICATIONS [TANTALDUENNSCHICHTKREISE FUER RAUMFLUGANWENDUNG]

H. Lauckner and R. Rossberg Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Oct. 1970 73 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.

(BMBW-FB-W-70-57) Avail: NTIS; ZLDI Munich: 14,90 DM

The manufacture of tantalum nitride films of 60 ohm sheet resistance is described. Using a line width of 25 micrometers and the same spacing, resistances of 4.8 megaohm per sq cm substrate can be obtained. The replacement of glass substrates by ceramic substrates was also studied. Tantalum resistor stability is improved by a sputtered tantalum oxide interlayer, so that unglazed ceramic substrates can be used for other purposes. Author (ESRO)

N71-17346*# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.

RESEARCH INTO ADVANCED CONCEPTS OF MICROWAVE POWER AMPLIFICATION AND GENERATION UTILIZING LINEAR BEAM DEVICES Semiannual Status Report

P. R. McIsaac Dec. 1970 23 p refs

(Grant NGL-33-010-047)

(NASA-CR-116490) Avail: NTIS CSCL 09A

The results are presented of a theoretical study of some aspects of the interaction between a drifting stream of electrons with transverse cyclotron motions and an electromagnetic field. Particular emphasis is given to the possible generation and amplification of millimeter waves. A discussion is given of two aspects of the theory of cyclotron resonance oscillators. First, the start oscillation conditions for a cyclotron resonance oscillator are discussed using the results of digital computer calculations based on a small signal, coupled mode theory of the device. Second, the formulation of a large signal analysis of the cyclotron resonance oscillator to explore those factors which determine the saturation power output and efficiency is discussed. Author

N71-17469*# Bendix Corp., Sidney, N.Y. Electrical Components Div.

MATERIALS INVESTIGATION AND TESTS FOR THE DEVELOPMENT OF SPACE COMPATIBLE ELECTRICAL CONNECTORS, PHASE 1 Final Report, 1 Jun. -30 Nov. 1970

D. E. Clark and J. E. McKeown 18 Dec. 1970 24 p refs

(Contract NAS8-26054)

(NASA-CR-10302) Avail: NTIS CSCL 09A

As improved semiconductor devices become available, it is anticipated that faster digital pulses will be used to transmit digital information between circuits and systems. This survey indicates that conventional multipin electrical connectors will become inadequate to transmit this information as pulse rise times enter the sub-nanosecond region. Outlined are techniques which are capable of determining the threshold of these rise times in existing connectors. Recommendations are made to establish limits of adequacy of existing connectors for such applications. Author

N71-17583*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PERFORMANCE CHARACTERISTICS OF IMPROVED SERVOAMPLIFIER FOR ELECTROHYDRAULIC CONTROL SYSTEMS

Peter G. Batterton and John R. Zeller Washington Feb. 1971 26 p refs

(NASA-TM-X-2167; E-5802) Avail: NTIS CSCL 09E

An improved servoamplifier was designed which has the capability of driving low-impedance servovalve torque-motor coils. Frequency response data are provided showing the performance of the improved servoamplifier - torque-motor combination. To aid in analytical studies, a simplified dynamic model of the amplifier - torque-motor-coil combination has been included with data for three coil impedances. It is shown that an improvement of at least 2 to 1 can be obtained by using a 40-ohm/coil instead of a 200-ohm/coil servovalve. The printed circuit cards of the improved servoamplifier are completely compatible with the original hand-wired design. Author

N71-17618*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SUPPORTING RESEARCH AND TECHNOLOGY
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 70–89 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 09E

The following topics in supporting research and technology are discussed: programmed input/output serial data generators and receivers, Mark 3A IBM 360/75 computer configuration, SFOF IBM 360/75 user device switching assemblies, thrust collar survey for DSS 14, hydrostatic bearing runner level reference, switched carrier experiments, and DSS 13 operations. R.B.

N71-17739# Hughes Aircraft Co., Culver City, Calif.
SOLID STATE PARAMETRIC PUMP SOURCE: DESIGN PLAN AND RELIABILITY PLAN
28 Sep. 1970 160 p
(Contract DAAB07-70-C-0141)
(AD-715022) Avail: NTIS CSCL 9/5

Information pertinent to the development of 42 GHz IMPATT power sources suitable for use as parametric amplifier pumps is given. Discussions of several decision areas are presented in order to arrive at the most desirable approach to the pump system. These decisions were made with consideration for the required power output, frequency stabilization, power level stability, and noise requirements, and were based, as much as possible, on experimental data. The proposed system consists of a stabilized IMPATT oscillator followed by an electronically leveled IMPATT amplifier. A promising back-up system consisting of a thermally controlled IMPATT oscillator is also proposed. The general specifications for the pump source depend heavily on the results of the various analyses and measurements discussed. This is especially so for the noise, power leveling, and frequency stability specifications. Author (GRA)

N71-17740# Naval Underwater Systems Center, New London, Conn.
CLIPPER DISTCRTION OF TWO NARROW-BAND PROCESSES IN GAUSSIAN NOISE
Albert H. Nuttall 17 Aug. 1970 43 p refs
(AD-715341; NUSC/NL-3027) Avail: NTIS CSCL 9/5

The envelopes of the output narrow-band components of a clipper, which is subjected to an input composed of two narrow-band processes and broad-band Gaussian noise, are evaluated for a variety of relative power levels. The collection of clipper output narrow-band components is composed of fundamentals, harmonics, and intermodulation products of the two input narrow-band components that may be either deterministic or random processes. The amplitudes and frequency locations of the components are evaluated quantitatively. When one of the input narrow-band components, denoted interference, is comparable in strength to the input noise, and the second input narrow-band component, denoted signal, is weaker, the harmonics of the interference and the low-order intermodulation products of the two components are significant in comparison with the fundamental output due to signal. Curves for all the significant output components for interference-to-noise ratios in the range −24 dB to +9 dB, in 3-dB increments, and signal-to-noise ratios in the range −43 dB to −3 dB are given. The effects of spectral foldover due to sampling the clipper output are easily evaluated from these results are discussed, as are the effects of amplitude-modulation of the input interference components on the clipper output components. Recommendations and methods of approach for future work are also presented. Author (GRA)

N71-17748# Office of Naval Research, London (England).
CONFERENCE ON SOLID STATE DEVICES
Richard O. Rowlands 6 Nov. 1970 13 p refs Conf. held at Exeter, England, 15–18 Sep. 1970
(AD-715101; ONRL-C-28-70; Rept-4) Avail: NTIS CSCL 9/1

The topics covered in this Conference ranged over the following areas: The economics of large scale integration; Crystal growth; Computer aided design, Microwave amplifiers; Lasers; Semiconductor memories; and, Special devices. Author (GRA)

N71-17749# Harry Diamond Labs., Washington, D.C.
MICROWAVE MIXER DIODE IMPEDANCE
Robert V. Garver Jun. 1970 39 p refs
(AD-714989; HDL-TR-1513) Avail: NTIS CSCL 9/1

The dependency of rf impedance on i-f impedance in diode mixers is clarified by visualizing the mixer as a frequency-changing attenuator. The contributions of series diode resistance to impedance and conversion loss are calculated. Microwave circuits for measuring and matching mixing diodes are presented to simulate properly the mixing environment in the measurement mount. Author (GRA)

N71-17773# North Caroline State Univ., Raleigh. Dept. of Engineering Research.
ON A NEW CONDITION FOR PHYSICAL REALIZABILITY OF PLANAR ANTENNAS
Donald R. Rhodes 25 Sep. 1970 20 p refs
(Contract F19628-70-C-0039)
(AD-715267; AFCRL-70-0182; SR-1) Avail: NTIS CSCL 9/5

The behavior that all physically realizable aperture distributions (tangential electric field in an aperture consisting of holes in a perfectly conducting planar sheet) must have at their edges is shown to be as follows. The components perpendicular and parallel to the aperture edge must each vanish with distance d from the edge as d(alpha), with alpha = 1 for the perpendicular component and alpha = 2 for the parallel component. An interesting consequence of this realizability condition is that the pedestal form of edge behavior usually assumed in aperture theory is physically impossible. Author (GRA)

N71-17774# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
A NEW APPROACH TO DESIGN NETWORKS HAVING A PRESCRIBED DRIVING-POINT IMPEDANCE IN BRUNE FASHION
Kurt H. Haase 26 Aug. 1970 79 p refs *Its* Phys. Sci. Res. Papers No. 427
(AD-715334; AFCRL-70-0473) Avail: NTIS CSCL 9/5

The design of networks having a prescribed driving-point impedance as a Brune one-port is well known and discussed in almost any textbook on linear and passive network synthesis. However, this classical design procedure is tedious, the more the degrees of the polynomials implied in the prescribed function increase. Besides that, numerical inaccuracies will be encountered. Also, this classical procedure can hardly be programmed for computer design. The modified version to be discussed in this paper yields explicit formulas by which all constants and polynomial coefficients of the requested circuit can be computed. Without any special effort, the results are extremely accurate. It is also shown that a Brune section has the property such that an inductance or a capacitance that appears as either a series or a shunt element at its input can, under certain conditions, be transposed over the section ti its output. This allows one to apply only one design program that covers all categories of driving-point functions which are realizable in the Brune fashion. Author (GRA)

N71-17850# IBM Watson Research Center, Yorktown Heights, N.Y.
INVESTIGATION OF HIGHLY-DOPED SCHOTTSKY-BARRIER FIELD-EFFECT TRANSISTORS
Karsten E. Drangeid 16 Jun. 1970 17 p
(Contract F19628-70-C-0094)

(AD-715282; AFCRL-70-0446; SR-1) Avail: NTIS CSCL 9/1

GaAs Schottky-barrier field-effect transistors were realized in the 1 micron structure with an f(max) up to 30 GHz (2.5 times higher than f(max) reported for other transistors). Details of measurements performed are reported and technological improvements obtained or still desired are discussed. For Si Schottky-barrier field-effect transistors, platinum and palladium as gate materials have shown improved breakdown behavior. Exploratory work has been started with devices with reduced carrier concentration at the Si-SiO2 interface to increase Schottky gate breakdown. The process of Si epitaxy has been adjusted to very low deposition rates (150 A/min) to enable controlled channel formation between 500 and 1000 A thickness. Author (GRA)

N71-17851# Army Electronics Command, Fort Monmouth, N.J. Radar Technical Area.

SHORT AXIAL LENGTH BROADBAND HORNS

John L. Kerr Oct. 1970 80 p refs

(AD-714994; ECOM-3344) Avail: NTIS CSCL 9/5

The report describes the development of two very broadband horns in which a substantial reduction in axial length, over that of earlier models, has been achieved. A significant requirement for both models is that of maintaining the half-power beam-width greater than thirty degrees over the very broad bandwidths involved. The first horn developed covers the frequency range from 1 GHz to 12 GHz with the flared portion of the horn having an axial length of six inches as compared with twelve inches for a previous design. The short axial length design was used as a basis in developing a very reasonably sized antenna operating in the range from 0.2 GHz to 2.0 GHz. A technique of fabricating the H-plane walls in the form of a grid was used in both horns as a means of controlling the H-plane patterns. The grid for the 1 GHz to 12 GHz horn was fabricated in printed circuit form while the grid elements of the lower frequency horn were made of aluminum tubing. Electrical performance characteristics of both models are presented in the form of radiations, VSWR, and gain curves. Author (GRA)

N71-17869*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A LITERATURE SURVEY OF SOME SURFACE AND SUBSURFACE PROCESSES AFFECTING MATERIALS IN THERMIONIC DIODES

Leonard K. Tower Washington Mar. 1971 39 p refs

(NASA-TM-X-2187; E-5987) Avail: NTIS CSLC 09E

A literature survey was conducted of surface and subsurface chemical and physical processes affecting materials in the thermionic diode. The processes considered were the evaporation and condensation of substrate materials, the bulk diffusion of metallic substrate materials, reactions between insulators and metals, and the surface self-diffusion and reconstruction of clean surfaces, faceting, and other surface reconstruction caused by contaminants or additives, solution, and oxidation. Author

N71-17893# Iowa State Univ. of Science and Technology, Ames.

LOCK-IN DETECTOR

Louis Mourlam, Jr. and Wayne A. Rhinehart Sep. 1970 34 p

(Contract W-7405-eng-82)

(IS-2389) Avail: NTIS

The fundamental principles involved in various lock-in detector systems are explained. Desirable features and shortcomings of each system are discussed. A procedure for evaluating the system most applicable to a particular experimental need is given. Basic operational problems which may occur in system usage are presented with suggested techniques for their solutions. A circuit design for a dual phase lock-in detector system is given and explained in detail. This system is especially useful for balancing AC bridges where the reactive and resistive components are being nulled simultaneously. Typical performance characteristics and operating data are listed. Helpful construction guides are given for building this low cost high performance detector. Author

N71-17935# Naval Ammunition Depot, Crane, Ind.

MICRO-NOTES: INFORMATION ON MICROELECTRONICS FOR NAVY EQUIPMENTS, ISSUE NO. 30

15 Oct. 1970 80 p

(AD-715108) Avail: NTIS CSCL 9/5

Contents: A continuing report on efforts to determine the theory and methods required to fabricate microcircuit ultra high speed prescalers; A summary of the work done on development of an LSI correlator; Minutes of the second meeting of the DOD/NASA committee on research and development of plastic devices and materials (WGR and D); A complete summary of work-to-date done on evaluation of plastic encapsulated integrated circuits. GRA

N71-17938# Harry Diamond Labs., Washington, D.C.

COMPUTER SYNTHESIS OF RADIATION PATTERNS. 1: SELECTROMAGNETIC RADIATION FROM CURRENT LOOPS ABOVE THE SURFACE OF A CONDUCTING CONE

Donald E. Wortman and Clyde A. Morrison Aug. 1970 34 p refs

(AD-714990; HDL-TR-1526) Avail: NTIS

The purpose of this work was to demonstrate that a particular preselected radiation pattern can be obtained for some desired antenna geometry by utilizing a new FORTRAN program written for use on an IBM-7094 computer. The selected radiation pattern is generated within the program and is compared with a computed pattern determined from a set of elements making up the antenna. The positions and phases of these elements are varied until the computed program matches, in some sense, the desired program at many angle points. The only requirement for this method is that the fields radiated by each element must either be approximated or calculated from first principles; i.e., Maxwells equations. Author (GRA)

N71-18023# National Bureau of Standards, Washington, D.C.

PHOTOMETRIC MEASUREMENTS OF 200-WATT TYPE PAR-64 HALOGEN-CYCLE VASI LAMPS

1969 8 p

Avail: NTIS

Test results of 200-watt VASI lamps, and a comparison with data on 300-watt VASI lamps are presented. The lamps were PAR-64 bulb halogen-cycle lamps with 2000-hour, 200-watt 6.6 ampere, off focus type CC-6 filaments. The photometric measurements were made in the VASI simulator which is described. Selected characteristics of 200-watt, and 300-watt lamps are tabulated. F.O.S.

N71-18051# Air Force Systems Command, Wright-Patterson AFB, Ohio.

PROSPECTS FOR THE USE OF LOW TEMPERATURES IN POWER ENGINEERING

V. V. Sychev et al 24 Jul. 1970 22 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Izd. Energ. i Transp. (USSR), no. 1, 1970 p 35–45

(AD-714797; FTD-HT-23-405-70) Avail: NTIS CSCL 9/1

Problems associated with creating superconducting and cryogenic electrode transmission lines are examined. Attention is devoted to selecting the type of current and line (cable) design. Special attention is devoted to the technical-economical and physicotechnical questions which play a decisive role in the structure and designing of superconducting and cryogenic lines. Cryogenic schemes are described which can guarantee precooling of the cables and maintenance of the working temperature during its

operation. Prospects for the development of electric machines (motors, generators) with a superconducting winding are analyzed, along with superconducting energy accumulators. Author (GRA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N71-16973# Joint Publications Research Service, Washington, D.C.
CYBERNETICS AND REGULATION THEORY
14 Dec. 1970 23 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 194, no. 4, 1970 p 743–746 and 754–757; no. 5, 1970 p 1021–1024 and 1029–1031
(JPRS-51982) Avail: NTIS

CONTENTS:

1. ERGODIC THEOREMS FOR MULTICHANNEL QUEUEING SYSTEMS p 1–6 (See N71-16974 07-10)
2. ALGORITHM FOR SOLVING THE PROBLEM OF MAXIMUM FLOW IN A NETWORK WITH AN EXPONENTIAL ERROR Ye. A. Dinits p 7–12 ref (See N70-16975 07-10)
3. THEOREM OF CODING STATEMENTS IN ARBITRARY LANGUAGES V. S. Proskurov p 13–18 refs (See N71-16976 07-08)
4. CARRYING CAPACITIES OF INFORMATION SYSTEMS WITH FEEDBACK AND INTERNAL NOISE V. V. Petrov et al p 19–22 refs (See N71-16977 07-08)

N71-16974# Joint Publications Research Service, Washington, D.C.
ERGODIC THEOREMS FOR MULTICHANNEL QUEUEING SYSTEMS
In its Cybernetics and Regulation Theory 14 Dec. 1970 p 1–6 (See N71-16973 07-10)
Avail: NTIS

Let a sequence of pairs of random variables be given in a primary probability space. It is stated that an m-channel queueing system with rejects is controlled by the sequence if the calls come to the system at given times and a time is spent on servicing the j-th call (if it exists). If the incoming call finds all m channels busy then it is rejected and dropped from consideration. If the number q sub n of busy channels at the time before arrival of the n-th call is less than m, then the call is accepted for servicing by one of the free channels. Author

N71-16975# Joint Publications Research Service, Washington, D.C.
ALGORITHM FOR SOLVING THE PROBLEM OF MAXIMUM FLOW IN A NETWORK WITH AN EXPONENTIAL ERROR
Ye. A. Dinits *In its* Cybernetics and Regulation Theory 14 Dec. 1970 p 7–12 ref (See N71-16973 07-10)
Avail: NTIS

Various versions of statement of the problem of maximum stationary flow in a network and its numerous applications are presented in a previous paper. In the same paper an algorithm is presented for solving the problem in the case where the initial data are integers. In the general case, this algorithm requires preliminary rounding of the initial data, that is, only an approximate solution of the problem is possible. Here, the estimate of the convergence rate of the algorithm is inversely proportional to the relative accuracy. An algorithm is proposed which exactly solves the problem in the general case in no more than Cn squared p (machine) operations where n is the number of nodes of the network, p is the number of arcs in it, and C is a constant which does not depend on the network. For integral data, this algorithm gives a numerical solution with an additional error in the number of operations C sub 1 np plus the estimate of the latter. Author

N71-16984# Lockheed Missiles and Space Co., Palo Alto, Calif.
UTILIZATION OF THE RECIPROCITY THEOREM
S. M. Rytov [1970] 9 p Transl. into ENGLISH from the book "Vvdenie v Statisticheskuiu Radiofiziku" Moscow, Nauka, 1965 p 323–335
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The principals in fluctuation electrodynamics are not the random electromagnetic field vectors themselves, but the mean values of the various bilinear and quadratic expressions composed from them. The electrodynamic reciprocity theorem affords a possibility for calculating these quantities directly, without first finding the random vectors themselves. The auxiliary diffraction problem of the field of a point source in the presence of the body under consideration is known for many bodies and can be used to obtain formulas for the bilinear quantities characterizing the fluctuation field, and in particular, the thermal radiation of these bodies. Author

N71-17092*# Radio Corp. of America, Camden, N.J. Advanced Technology Labs.
C-MOS ARRAY DESIGN TECHNIQUES Final Quarterly Report, 15 Sep.–15 Dec. 1970
A. Feller Dec. 1970 67 p ref
(Contract NAS12-2235)
(NASA-CR-116440) Avail: NTIS CSCL 09C

A CMOS standard cell test chip has been fabricated and tested. This chip contains most of the logic circuits of the standard cell family. The results of the extensive testing and evaluation of the fabricated chip confirms that all the objectives and goals were successfully accomplished. These successful accomplishments include modification of the C-MOS automatic placement, routing, folding and artwork design automation computer programs, the design of the basic C-MOS cell and chip topology, the design and validation of the standard cell circuit family, and the integration of all these capabilities into a tool for low-cost and quick-turnaround generation of LSI C-MOS integrated circuit arrays. Author

N71-17472*# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
PERFORMANCE IMPROVEMENT ANALYSIS FOR THE APOLLO UNIFIED S-BAND SYSTEM Final Report, Sep. 1968–Aug. 1970
R. D. Sheldon 1 Dec. 1970 14 p ref
(Grant NGR-44-011-026)
(NASA-CR-116515) Avail: NTIS CSCL 09C

Progress reported in the development of communications systems analyses techniques for improved performance of the Apollo unified S-band system is outlined. Six dissertations and master's reports, eight technical papers, and the monthly progress report have been produced and it is shown how each of these documents contributes to the grant objective. Considered were: (1) computer simulation of communication system; (2) computer aided analysis; (3) phase lock loop performance; (4) angle modulation distortion analysis; and (5) new methods of signal parameter estimation. G.G.

N71-17473*# Bellcomm, Inc., Washington, D.C.
TRACKING ANALYSIS OF A FIRST ORDER PHASE-LOCKED LOOP WITH TWO SINEWAVES MODULATION

S. Y. Lee and L. D. Nelson 21 Jan. 1971 17 p refs
(Contract NASw-417)
(NASA-CR-116506; TM-71-1033-1) Avail: NTIS CSCL 09C

A tracking analysis of a first order phase-locked loop with two sinewaves modulation is presented. By assuming the fluctuation about the d-c value of the phase error (not necessarily the total error) to be small, a linearized model is obtained. A periodic solution of this model is then derived for the output phase of the first order loop. It is shown that this periodic solution is unique. Using this periodic solution, analytical tracking behaviors of the output phase of this model are obtained. Computer plots of the phase error for some typical parameters used in Apollo communication systems are included. Author

N71-17871*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
STABLE ADAPTIVE CONTROL WITH GAIN CONSTRAINTS
D. P. Lindorff Feb. 1971 14 p refs
(GRANT NGL-07-002-002)
(NASA-CR-116428) Avail: NTIS CSCL 09C

In the designing of stable model tracking adaptive systems the complexity of instrumentation and the presence of measurement noise are likely to be the factors which most severely limit the practicality of the design. The problem dealt with involves the desire to reduce the noise entering the system, and at the same time to find possibilities for simplifying the complexity of the adaptive controller. The essential idea is to consider the problem in which some of the compensating gains are fixed at nominal values, as would be justified if the associated plant parameters are known with sufficient accuracy. Hence the adaptive control is applied only to those terms in which the parameters are known with poor accuracy. Using this approach the tracking error will not in general be asymptotically stable, and a criterion is needed to establish that the error will in fact be satisfactorily bounded. The object of the study is to derive a test for such a bound. The result is a sufficient condition for Lagrange stability which, though conservative, offers a basis for design. Author

N71-17872*# Westinghouse Electric Corp., Linthicum Heights, Md. Molecular Electronics Div.
[A LOW POWER NAND GATE INTEGRATED CIRCUIT EMPLOYING THIN FILM RESISTORS AND LATERAL P-N-P TRANSISTORS] Final Engineering Report
[1970] 49 p
(Contract NAS8-20812)
(NASA-CR-116421) Avail: NTIS CSCL 09C

A low power NAND gate integrated circuit employing thin film resistors and lateral p-n-p transistors is described. A novel circuit with either active or resistor pull up was designed to achieve the low power dissipation. In features p-n-p-n switching action and unity gain p-n-p and n-p-n transistors. The design, fabrication, and evaluation of the circuit is discussed in detail. Author

N71-17939# Harry Diamond Labs., Washington, D.C.
PULSE E FIELD MONITOR
Michael T. Vrabel and Philip S. Brody Aug. 1970 16 p
(AD-714988; HDL-TR-1475) Avail: NTIS CSCL 14/2

Ceramic BaTiO3 was successfully employed as a passive monitoring device for pulsed electric fields in the 1,000,000 to 10 to the 7th power V/m range and for pulse durations as short as 20 ns. An initially unpolarized BaTiO3 ceramic disk was subjected to the pulsed E-field. The pulsed E-field produced a net spontaneous polarization in the material. The magnitude of this polarization could be correlated with the magnitude of the E-field. The polarizations thus produced are typically of the order of several percent of saturation polarization. Once polarized, the material is piezoelectric. The piezoelectric output of the disk could be easily measured by applying a pressure of about 40 lb on the specimen and measuring the charge induced by pressure with an electrometer. Author (GRA)

N71-18062*# Rensselaer Polytechnic Inst., Troy, N.Y. Systems Engineering Div.
OPTIMAL TIME INVARIANT OUTPUT FEEDBACK CONTROLLERS, VOLUME 1 Final Report, 4 Nov. 1969–4 Apr. 1970
Derek E. McBrinn 4 Apr. 1970 152 p refs Sponsored in part by NDEA and Ling Temco Vought, Inc.
(Contract NAS8-21131)
(NASA-CR-103032) Avail: NTIS CSCL 09C

The problem of the determination of optimal time-invariant output feedback controllers for linear dynamic systems with quadratic cost functionals is considered. Two distinct cases arise, depending on whether optimization is over a finite or a semi-infinite time interval. For the semi-infinite time interval problem a gain initialization technique is derived to complement existing optimization techniques. The gain initialization technique determines the feedback gains required to (locally) maximize the system stability. A computational algorithm for the technique is incorporated in a digital computer program, and is used to stabilize a seven state model of a Saturn 5 booster rocket. For the finite time interval problem a technique is derived to (locally) minimize the expected value of the cost functional. The technique uses the concept of initial state averaging. A computational algorithm is provided and incorporated in a digital computer program. The technique is illustrated by three examples. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N71-18987# Oklahoma Univ. Research Inst., Norman.
STATE OF OKLAHOMA AIRPORT PLAN
May 1970 150 p refs Sponsored in part by Okla. Aeron. Comm. and HUD Prepared for Okla. Ind. Develop. and Park Dept. and Okla. Aeron. Comm.
(PB-194937) Avail: NTIS CSCL 01E

A systematic plan for airport development over the time period to 1980 was considered. To accomplish this task, the project was separated into five work elements: (1) verification and classification of airports; (2) determinants of airport facilities; (3) aviation development model; (4) test of the model; (5) schedule of projected investments for Oklahoma airports. Author (GRA)

N71-18988# Regional Planning Commission, Cleveland, Ohio.
DATA FILE EDITING AND PRELIMINARY ANALYSIS, CLEVELAND-HOPKINS AIRPORT ACCESS STUDY Final Report
May 1970 174 p
(Contract DOT-OS-A9-023)
(PB-195047; DOT-OS-A9-023-3) Avail: NTIS CSCL 13B

An analysis of the impact of the rapid rail extensions on airport users was conducted before the opening of the rail transit service to the airport and another survey was conducted one year later after the rail rapid service was opened. The data from these surveys were compared to determine the effect of the new rail transit service on the choice of travel mode by the different groups of airport users. The report documents the procedures used in the preparation of files for analysis of the surveys. Author (GRA)

N71-18989# Regional Planning Commission, Cleveland, Ohio.
DATA FILE FORMATS AND CODE DESCRIPTIONS,

CLEVELAND-HOPKINS AIRPORT ACCESS STUDY Final Report
Jun. 1970 90 p
(Contract DOT-OS-A9-023)
(PB-195048; DOT-OS-A9-023-4) Avail: NTIS CSCL 13B

The impact of rapid rail extension was analyzed. A survey of airport users was conducted before the opening of the rail transit service to the airport and another survey was conducted one year later after the rail rapid service was opened. The data from these surveys were compared to determine the effect of the new rail transit service on the choice of travel mode by the different groups of airport users. The report documents the file formats and code descriptions for the survey data tape. Author (GRA)

N71-16990# Regional Planning Commission, Cleveland, Ohio.
CLEVELAND-HOPKINS AIRPORT ACCESS STUDY: SURVEY RESULTS Final Report
Jun. 1970 163 p
(Contract DOT-OS-A9-023)
(PB-195045; DOT-OS-A9-023-1) Avail: NTIS CSCL 13B

A survey of airport users was conducted before the opening of the rail transit service to the airport and another survey was conducted one year later after the rail rapid service was opened. The data from these surveys were compared to determine the effect of the new rail transit service on the choice of travel mode by the different groups of airport users. The report compares the results of the surveys. Author (GRA)

N71-16991# Regional Planning Commission, Cleveland, Ohio.
CLEVELAND-HOPKINS AIRPORT ACCESS STUDY: AIR PASSENGER SURVEY SELECTED TABULATIONS Final Report
Jun. 1970 275 p
(Contract DOT-OS-A9-023)
(PB-195049; DOT-OS-A9-023-5) Avail: NTIS CSCL 13B

An analysis of the impact of the rapid rail extension to Hopkins Airport was performed. A survey of airport users at Hopkins Airport was conducted before the opening of the rail transit service to the airport and another survey was conducted one year later after the rail rapid service was opened. The data from these surveys were compared to determine the effect of the new rail transit service on the choice of travel mode by the different groups of airport users. The report presents selected tabulations. Author (GRA)

N71-16992# Regional Planning Commission, Cleveland, Ohio.
CLEVELAND-HOPKINS AIRPORT ACCESS STUDY: SURVEY PROCEDURES Final Report
May 1970 126 p
(Contract DOT-OS-A9-023)
(PB-195046; DOT-OS-A9-023-2) Avail: NTIS CSCL 13B

Analyzed is the impact of rapid rail extension to Hopkins Airport. A survey of airport users at Hopkins Airport was conducted before the opening of the Cleveland Transit System rail transit service to the airport and another survey was conducted one year later after the rail rapid service was opened. The data from these surveys were compared to determine the effect of the new rail transit service on the choice of travel mode by the different groups of airport users. This report documents the procedures used in the surveys. Author (GRA)

N71-17046# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
DATA ACQUISITION ON HYPERSONIC WIND TUNNELS [MESSWERTERFASSUNG AN HYPERSCHALLWINDKANAELEN]
Josef Thelen Sep. 1970 47 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-44) Avail: NTIS; ZLDI Munich: 14,10 DM

A digital data acquisition system for hypersonic wind tunnels is described. The hardware controlled system scans up to 50 channels at high speed (10,000 measurements/sec), digitizes the input signals, and records them on magnetic tape. The data are punched on paper tape for further processing in a computing center. Author (ESRO)

N71-17061# National Physical Lab., Teddington (England). Aerodynamics Div.
AN ANALYSIS OF SOURCES OF ERROR IN TYPICAL PRESSURE MEASUREMENTS IN A BLOWDOWN SUPERSONIC TUNNEL
P. G. Pugh and J. Peto Nov. 1969 24 p refs
(NPL-AERO-1306; ARC-31585) Avail: NTIS

Pressure measurement errors at supersonic speeds due to transducer calibration, electrical noise, transducer nonlinearity, test section flow non-uniformity, model manufacturing tolerances, as well as static hole diameter, depth, position, and quality were separately identified. The accuracy of pressure measurements in blowdown supersonic wind tunnels is also discussed. Author (ESRO)

N71-17089# Association Internationale des Constructeurs de Materiel Aerospatial, Paris (France).
INVENTORY OF THE PRINCIPAL EUROPEAN WIND TUNNELS CAPABLE OF BEING USED FOR AERODYNAMIC TESTS IN THE POST APOLLO PROGRAM
J. Brocard 1970 9 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22–25 Sep. 1970
Avail: NTIS

Size, stagnation pressure, Reynolds number and Mach number ranges of European wind tunnels operating in the subsonic, transonic, supersonic, and hypersonic ranges, and at low density, are tabulated. ESRO

N71-17100# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
AN INVESTIGATION OF THE STRESSES IN A WIND TUNNEL CORNER SECTION
D. E. W. Stone and P. S. A. Baxter London Aeron. Res. Council 1970 62 p refs Supersedes RAE-TR-69021; ARC-31468
(ARC-CP-1117; RAE-TR-69021; ARC-31468) Copyright. Avail: NTIS; HMSO: 75p; BIS: $3.00

The stresses were studied with a 1/8 scale model and both the brittle coating technique and elevated temperature strain gages were employed. The thermal and pressure stresses were simulated separately. Author (ESRO)

N71-17140# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
THE PLASMA JET WIND TUNNEL PK2 OF THE DFVLR INSTITUTE OF APPLIED GAS DYNAMICS: DESIGN AND DESCRIPTION OF THE TUNNEL [DER PLASMAWINDKANAL PK2 DES DFVLR-INSTITUTS FUER ANGEWANDTE GASDYNAMIK: AUSLEGUNG UND BESCHREIBUNG DER ANLAGE]
Martin Fiebig and Wilhelm Neuberger Aug. 1970 100 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-35) Avail: NTIS; ZLDI Munich: 30.50 DM

The expected operational range of the arc heated wind tunnel is discussed. The working domain is determined by the vacuum pumping system (approximately 100,000 cu m/h in the pressure range from 0.005 to 0.5 torr), the DC power supply (1.4

MW), the arc heaters (max. stagnation pressure 10 atm), and the diffuser effectiveness. It is designed for fluid, mechanical, and material investigations at high velocities and low densities.
Author (ESRO)

N71-17345*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
CONTROL OF DISTRIBUTED PARAMETER SYSTEMS AS APPLIED TO A LUNAR LANDING VEHICLE SIMULATOR
George W. Starkweather Jan. 1971 59 p refs Revised
(Grant NGL-07-002-002)
(NASA-CR-116482) Avail: NTIS CSCL 14B

A study was undertaken for the purpose of obtaining an improved feedback control for a lunar landing vehicle simulator. The simulator, used to train astronauts for lunar landing, consists of a cable supported, rocket propelled vehicle. The lunar gravity is simulated by maintaining tension on the cable equal to 5/6 of the vehicle weight. A drum, onto which the cable is wound, is controlled to keep the proper tension on the cable, and to allow the cable length to be changed. The scope of the investigation is restricted to a study of vehicular motion along a horizontal coordinate axis. Since for small perturbations the responses of the system along the three axes are decoupled, the study can to a first approximation be readily generalized to include the three dimensional case.
Author

N71-17367*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPROXIMATE TREATMENT OF V/STOL WALL INTERFERENCE FOR CLOSED CIRCULAR TUNNELS
Harry H. Heyson Washington Feb. 1971 33 p refs
(NASA-TN-D-6127; L-7449) Avail: NTIS CSCL 14B

An approximate treatment of V/STOL wall interference in a circular tunnel indicates that the interference factors at the model for this tunnel should be of the same order of magnitude as those presently available for a square tunnel of equal cross-sectional area. There is a greater degree of uncertainty with respect to the lateral and longitudinal distributions of interference; however, the available results for the square tunnel should be reasonably close to those of the circular tunnel provided that the model is relatively small in comparison with the test section.
Author

N71-17451*# Research, Inc., Minneapolis, Minn. Controls Div.
EQUIPMENT TO SIMULATE AERODYNAMIC HEATING AND ACOUSTICAL ENVIRONMENTS ON SPACE SHUTTLE THERMAL PROTECTION SYSTEM SPECIMENS, INSTRUCTION MANUAL
15 Jan. 1971 79 p
(Contract NAS8-26297)
(NASA-CR-103017) Avail: NTIS CSCL 14B

The equipment, specifications, and operating procedure for test equipment related to simulating aerodynamic heating and acoustical environments on space shuttle thermal protection system specimens are described.
Author

N71-17546# Federal Aviation Administration, Washington, D.C. Airports Service.
PLANNING THE METROPOLITAN AIRPORT SYSTEM
May 1970 111 p refs Original Contains Color Illustrations
(FAA-AC-150/5070-5) Avail: SOD $1.25

A systematic approach to planning for the nation's airport needs is presented. The metropolitan airport system planning process involves the preparation of both broad and specific policies, plans, and programs needed to establish a viable, integrated network of airports at the metropolitan level. The planning process is described in detail under the following chapter headings: (1) organization for the planning process, (2) funding the planning process, (3) general criteria and policy objectives, (4) study design, (5) inventories, (6) forecasting, (7) consideration of new technology, (8) general facility requirements, (9) development of alternative system plans, (10) plan implementation, and (11) the continuing planning process.
D.L.G.

N71-17600* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BURST DIAPHRAGM FLOW INITIATOR Patent
John W. Davis and Olen E. Hill, inventors (to NASA) Issued 30 Sep. 1969 (Filed 28 Dec. 1967) 6 p Cl. 220-89; Int. Cl. B65d25/00
(NASA-Case-MFS-12915; US-Patent-3,469,734; US-Patent-Appl-SN-694340) Avail: US Patent Office CSCL 14B

A burst diaphragm flow initiator is described that is capable of initiating the flow of gas from a relatively high pressure reservoir to a relatively low pressure receiver within a few milliseconds. It is designed for use in short duration wind tunnels with ultrarapid opening response and without the shading of undesirable particles during the flow initiating period. The device comprises a multiple element grid support within a gas conducting tube with the grid support housing a reciprocating cutter. A diaphragm made of a plastic is supported on the grid elements, normal to the gas flow, with the diaphragm being stressed against the grid support elements. When gas flow initiation is desired the cutter is actuated and shears the diaphragm into a number of distinct petals and the pressurized gas forces the light petals to the full open position in a period of a few milliseconds.
D.L.G.

N71-17619*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SFOF DEVELOPMENT
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 90–98 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 14B

SFOF development is reported on the following topics: functional design of the Facility for the 1970–1972 era, video image display assembly, and discernibility of cathode ray tube gray shades.
R.B.

N71-17620*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GCF DEVELOPMENT
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 99–113 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 14B

Development of the Ground Communications Facility is reported, including the Facility functional design for 1971–1972, high-speed system design Mark 3A, high-speed data block demultiplexer, wideband digital data system terminal configuration, and communications control group assembly voice data switching equipment.
R.B.

N71-17625*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FACILITY ENGINEERING
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 154–160 (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 14B

Modifications and construction to convert the DSS 61/63 facility to an 85-ft-diam/210-ft-diam antenna complex are described. Power plant reconfiguration of the 85-ft-diam antenna tracking station is also discussed.
R.B.

N71-17697# Committee on the District of Columbia (U.S. Senate).
UTILIZATION AND FUTURE OF MAJOR AIRPORTS IN THE NATIONAL CAPITAL REGION. PART 2: STRETCH JETS AT NATIONAL AIRPORT

Washington GPO 1970 175 p refs Hearings before Comm. on the District of Columbia, 91st Congr., 2d Sess., 19 May 1970
Avail: Subcomm. on Business and Commerce

Discussions in support of and against permitting Boeing 727 jets to land at Washington National Airport are presented. Specific problems associated with the jet use of the airport, overall impact on affected and other airlines, phasing controls, premium fees, and community relations are covered. A study of the Baltimore/Washington biregional air facilities plan and program, and a staff information report on the current and future prospects, problems, and needs of the National Airport are included. N.E.N.

N71-17852# Naval Research Lab., Washington, D.C. Cyclotron Branch.
REPORT OF CYCLOTRON OPERATION, 1 JANUARY–30 JUNE 1970
Sep. 1970 44 p refs
(AD-715109; NRL-MR-2174) Avail: NTIS CSCL 20/7

Progress in the experimental program using the NRL Sector-Focusing Cyclotron during the period 1 January - 30 June 1970 is briefly described. Additionally, improvements in the research potential of the facility through various developmental activities are reported. Lastly, a summary of operational efficiency and allocation of beam time to the different experimental programs, and outside users groups is included. Author (GRA)

N71-17876*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DRILLED-CORE STORAGE HEATER FOR A HYPERSONIC TUNNEL
Erwin A. Lezberg Washington Mar. 1971 23 p refs
(NASA-TM-X-2202; E-5850) Avail: NTIS CSCL 14B

A design for a graphite drilled-core storage heater for supplying heated nitrogen gas to a hypersonic propulsion facility was developed using results from a transient-heat-transfer program. Hole size and spacing were determined from the results of the computer program and from consideration of thermal stress and cost factors. A model of the proposed matrix design was fabricated and tested in a pilot storage heater facility to evaluate thermal stress limitations and to compare performance of the heater with predictions based on the heat-transfer calculations. No cracking or deterioration of the matrix had occurred during the test program. Measured matrix temperatures were only in fair agreement with the results of a two-dimensional transient-heat-transfer program, but the discrepancies are believed to be due to thermocouple installation errors. Author

N71-18038# Boeing Scientific Research Labs., Seattle, Wash. Environmental Sciences Lab.
SOME ALGEBRAIC SOLUTIONS OF THE CYCLOTRON RESONANCE INTERACTION
H. S. Ho (Wash. Univ., Seattle) and H. B. Liemohn Sep. 1970 39 p refs
(D1-82-1010) Avail: NTIS

The cyclotron-resonance interaction between electromagnetic waves and nonthermal plasmas was investigated for Cauchy (resonance) velocity distributions which yield algebraic dispersion equations. Combinations of anisotropic and streaming distributions were considered for ions and electrons to ascertain the relative importance of the interaction at different frequencies. Distribution forms and parameter ranges were chosen which would simulate possible conditions in the magnetosphere and solar wind. Because the equations are algebraic, the valid characteristic roots are readily identified, and their unstable nature is determined by conventional convective/nonconvective criteria. Parameter regimes of spatial amplification (convective instability) and temporal growth (nonconvective instability) were identified. Amplitude exponents are presented as a function of frequency for several cases of interest, and algebraic expansions are derived. It is concluded that the cyclotron-resonance interaction is a convective instability for parameter values appropriate for the undisturbed magnetosphere and solar wind. Nonconvective instabilities are only obtained for relatively large streaming conditions which may be encountered in laboratory or stellar applications. Author

N71-18099# Regional Science Research Inst., Philadelphia, Pa.
ECONOMIC IMPACT OF THE DALLAS-FORT WORTH REGIONAL AIRPORT ON THE NORTH CENTRAL TEXAS REGION IN 1976
Robert E. Coughlin, Robert C. Douglas, Thomas W. Langford, Jr., and Benjamin H. Stevens Jan. 1970 78 p refs Sponsored in part by Dept. of Housing and Urban Develop.
Avail: NTIS

Air transportation activities are projected for the Dallas-Fort Worth area. Proposed dollar value of purchases and employment resulting from airport construction are discussed, emphasizing cost per unit, output determination from operating levels, adjustment for increased productivity, and total output and employment. Gross and net economic impact of purchases by airport activities of north central Texas region are reviewed, along with air transportation and regional growth. J.A.M.

N71-18101# Federal Aviation Administration, Washington, D.C.
ALPA: A SURVEY OF AIRPORT FIRE AND RESCUE FACILITIES
B. V. Hewes 1970 84 p
Avail: NTIS

The annual survey of crash fire and rescue equipment at airports being served on at least a daily basis by the 11 trunks, 9 local service and 7 Alaskan and Hawaiian airlines is presented. Airports served exclusively by third level or airline operators are not included due to the problems encountered when collecting the necessary data. The purpose of the survey is to: (a) inform the airline pilot of the crash fire and rescue equipment available at the airports and (b) inform government agencies, airline authorities and other responsible groups and individuals of the facts concerning the status of crash fire and rescue equipment at North American and Canadian airports. Author

N71-18113# National Bureau of Standards, Washington, D.C.
PHOTOMETRIC TESTS OF TWO OMNIDIRECTIONAL SEMIFLUSH AIRPORT LIGHTS. TEST REPORT
20 Apr. 1970 10 p Sponsored by Navy
Avail: NTIS

The results of intensity distribution measurements of a one-inch-high projection (B-3 type) omnidirectional semiflush airport light and a one-half-inch-high projection light (BB-3 type) are given. Each of the lights has a conventional clear glass and a redesigned spread lens. Horizontal and vertical intensity distributions of the two lights are shown. The vertical distributions were taken through the horizontal angles of the minimum and maximum intensities of the horizontal traverses. Author

N71-18126# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
MODELING OF THE MAGNETIC SYSTEM OF THE JINR PHASOTRON WITH A SPATIAL FIELD VARIATION
Yu. G. Alenitskii, S. B. Vorozhtsov, N. L. Zaplatin, and L. K. Lytkin 1970 23 p refs In RUSSIAN
(JINR-P9-5246) Avail: AEC Depository Libraries

The results of the model investigation of the magnetic system of the phasotron with a spatial field variation are given. The required field variation is formed. The average field differs from the required one by + or − 70 Oe. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N71-16925# Admiralty Experiment Works, Haslar (England).
THE PROBLEM OF AN INFINITELY LONG CIRCULAR CYLINDER IN AN OBLIQUE SEA
W. E. Boulton Jul. 1970 93 p refs
(AD-713302; AEW-8/70) Avail: NTIS CSCL 20/4

A fixed infinitely long circular cylinder half submerged in, and with its axis in the free surface of an ideal fluid is considered. This cylinder is acted upon by a regular wave train whose direction of motion makes an oblique angle with the axis of the cylinder. The object of the paper is to find the vertical force per unit length on the cylinder due to these waves. Author (GRA)

N71-16926# Dartmouth Coll., Hanover, N.H. Thayer School of Engineering.
TWO-PHASE ANNULAR FLOW IN PIPES: ANALYTICAL MODELS
Dan A. Sullivan and Graham B. Wallis Aug. 1970 88 p refs
(Grant NSF GK-1841)
(PB-194836; Rept-27327-10) Avail: NTIS CSCL 20D

Analytical models describing two-phase annular flow are derived from fundamental principles. The models are developed in increasing levels of sophistication beginning with a simple one-dimensional model, proceeding to several integral techniques, and ending with a detailed derivation of a differential analysis. The general differential analysis is based on two equations: (1) the shear stress equation and (2) the shear stress-velocity gradient relationship. The physical model is divided into three regions: (1) the liquid film, (2) the interface, and (3) the gas core. Each region is analyzed separately. A universal velocity profile law for the gas core is developed which appears to apply for entrainment fractions less than 40%. Author (GRA)

N71-16935# Lockheed Missiles and Space Co., Palo Alto, Calif.
PECULIARITIES IN THE PROPAGATION OF WEAK PERTURBATIONS IN TWO-PHASE MEDIA WITH PHASE TRANSITIONS
A. I. Ivandaev et al [1970] 6 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 5, 1970 p 73–77
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The propagation of weak perturbations in two-phase media, being a gas mixture with drops or particles, is investigated taking account of possible phase transitions, on the basis of the linearized equations of hydromechanics, and the equations of state of the phases. Dependences of the wave vector on the frequency of perturbation are obtained. The influence of mass exchange between the phases on the character of the dispersion is estimated. Author

N71-16936# Lockheed Missiles and Space Co., Palo Alto, Calif.
STRUCTURE OF THE SUPERSONIC JET OF AN ARGON-HELIUM MIXTURE IN A VACUUM
A. A. Bochkarev et al [1970] 8 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekh. Fiz. (USSR), no. 5, 1970 p 158–163
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results are presented of an experimental investigation of barodiffusion processes in supersonic jets of an argon mixture with helium by using a beam of electrons. Experiments are based on utilizing electron-beam diagnostics, which induces no perturbations in the supersonic flow and permits the actual picture of the gas mixture flow to be obtained. New results of an investigation of the effects in gradient flows are presented. Author

N71-16937# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE INTEGRATION OF A SYSTEM OF LINEARIZED NAVIER-STOKES EQUATIONS
M. P. Grigoliia [1970] 11 p refs Transl. into ENGLISH from Tr. Tbilissk. Mat. Inst., Akad. Nauk Gruzin SSR (Tiflis), v. 35, 1969 p 32–44
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

On the basis of known existence and uniqueness theorems, a solution of the fundamental boundary value problem for a system of linearized Navier-Stokes equations is constructed by a new method, called the method of generalized Fourier series. Author

N71-16938# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE NECESSARY CONDITION FOR THREE-DIMENSIONAL BOUNDARY LAYER SEPARATION
G. M. Bam-Zelikovich [1970] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 2, 1970 p 109–113
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Inadequacies of determinations of the three-boundary layer line of separation are shown. On the basis of an analysis of the phenomena originating in boundary layer separation, it is found that the necessary condition for three-dimensional boundary layer separation is the presence of a line on the streamlined surface, at which the streamlines near the wall are perpendicular to the pressure gradient. Possible configurations of reverse current zones of a three-dimensional boundary layer are considered Author

N71-16946# Lockheed Missiles and Space Co., Palo Alto, Calif.
SUBSONIC COMPRESSIBLE GAS FLOW AROUND A SEMI-INFINITE PLATE IN A CHANNEL
B. S. Kirnasov et al [1970] 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, Mekh. Zhidk. Gaza (USSR), no. 4, 1970 p 101–108
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Subsonic ideal compressible gas flow around the base cut of a semi-infinite plate placed in a channel is considered. The flow scheme use is analogous to the D. A. Efros scheme with a return jet for the cavitation flows. A. S. V. Fal'kovich method, which permits finding the solution in problems of gas jets with several characteristic velocities, is applied to solve the problem. This method is a generalization of the S. A. Chaplygin method for jet problems with one characteristic velocity. Author

N71-16949# Lockheed Missiles and Space Co., Palo Alto, Calif.
KINETIC THEORY OF GAS MIXTURES TAKING ACCOUNT OF IRREVERSIBLE THERMODYNAMICS LAW
A. D. Khonkin [1970] 7 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 4, 1970 p 44–50
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The derivation of hydrodynamics equations for a gas mixture from the system of Boltzmann kinetic equations is analyzed. The form of the hydrodynamics equations results uniquely from the necessary and sufficient conditions for the solvability of systems of linear integral equations with symmetric kernels which determine

terms in the expansion of the distribution functions in series in the spatial inhomogeneity parameter (in the Knudsen number). The transport laws are represented in a form for which the Onsager symmetry relations are valid. The symmetry properties of integral operators resulting from the invariance of the mechanics equations relative to transformations changing the sign of the time and the particle momentum are utilized in deducing the Onsager relations. The Onsager relations are also derived from expressions for the kinetic coefficients in terms of the correlation functions. Author

N71-16950# Lockheed Missiles and Space Co., Palo Alto, Calif.
PLANE-PARALLEL TRANSONIC FLOW WITH A DISCONTINUITY
I. Biibosunov et al [1970] 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 4, 1970 p 95–100
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Plane parallel transonic flow with a compression shock terminating within the flow is analyzed where the shock is considered curved. A line of discontinuity is located ahead of the compression shock in the supersonic zone. The problem is solved by the method of undetermined coefficients. Author

N71-16951# Lockheed Missiles and Space Co., Palo Alto, Calif.
VISCOUS HYPERSONIC FLOW AROUND A NONAXISYMMETRIC SLENDER BODY
M. D. Ladyzhenskii [1970] 9 p refs Transl. into ENGLISH of the book "Prostransvennye Giperzvudkovye Techeniia Gaza" Moscow, Mashinostroenie, 1968 p 47–58
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results are presented of a numerical computation of viscous hypersonic flow around a nonaxisymmetric, slender, elongated body whose generator in each meridian plane is the parabola y is approximately $x(3/4)$. It is assumed that the streamlined body differs slightly from a body of revolution. As the computational results show, the lift on the body for the case of a heat insulated wall exceeds the lift in an inviscid flow. Author

N71-16952# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE NECESSARY CONDITION FOR THREE-DIMENSIONAL BOUNDARY LAYER SEPARATION
G. M. Bam-Zelikovich [1970] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (USSR), no. 2, 1970 p 109–113
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Inadequacies of determinations of the three-dimensional boundary layer line of separation are shown. On the basis of an analysis of the phenomena originating in boundary layer separation, it is found that the necessary condition for three-dimensional boundary layer separation is the presence of a line on the streamlined surface, at which the streamlines near the wall are perpendicular to the pressure gradient. Possible configurations of reverse current zones of a three-dimensional boundary layer are considered. Author

N71-16967# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON CRITERIA OF THREE-DIMENSIONAL BOUNDARY LAYER SEPARATION
G. M. Bam-Zelikovich [1970] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (USSR), no. 4, 1970 p 50–54
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Assuming that the flow character in a boundary layer section depends only on the external flow behavior in a small area, criteria are derived for laminar and turbulent boundary layer separation in three dimensional flow. The line separation on a pointed cone coinciding with a cone generator is in agreement with experimental results. Author

N71-17044# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
TEMPERATURE AND FLUID PROPERTY EFFECTS ON CAVITATION IN AIRCRAFT FUEL PUMPS
W. G. S. Lester London Aeron. Res. Council 1970 27 p refs Supersedes RAE-TR-69165; ARC-31725
(ARC-CP-1128; RAE-TR-69165; ARC-31725) Copyright. Avail: NTIS; HMSO: 40p; BIS: $1.60

Problems of measuring net positive suction head (NPSH) are considered and a test technique for examining cavitation performance using a closed loop system is described. Results from a small booster pump operating in water and kerosene fuel confirmed that less NPSH is required to pump the fluids at elevated temperatures than when cold. The pump performance with kerosene was inferior to that with cold water as NPSH is reduced due to the difference in air solubility between the two fluids. Prediction of pump cavitation performance in aircraft fuels will be difficult because of the influence of dissolved air content and the dependence of the vapor pressure of multi-component fluids on vapor/liquid ratios. Author (ESRO)

N71-17080# Manchester Univ. (England). Dept. of the Mechanics of Fluids.
NON-EQUILIBRIUM EMISSIVITY OF CARBON DIOXIDE NEAR 4.3 MICRON
J. P. Hodgson London Aeron. Res. Council 1970 15 p refs Sponsored by Sci. Res. Council Supersedes ARC-31266
(ARC-CP-1116; ARC-31266) Copyright. Avail: NTIS; HMSO: 20p; BIS: 80c

Emissivity calculations were made for gas samples not in vibrational equilibrium. The method was based on an equilibrium calculation and required specification of the vibrational, rotational, and translational temperatures. The calculations were used along with shock tube experiments to study the vibrational relaxation region of shock waves but are generally valid for uniform samples. Author (ESRO)

N71-17087*# City Coll. Research Foundation, New York.
THE STABILITY OF A FILAMENT OF A VISCOELASTIC FLUID
Joseph Yerushalmi (Ph.D. Thesis) 1969 219 p refs
(Grant NGR-33-013-009)
(NASA-CR-116438) Avail: NTIS CSCL 20D

The stability of a filament of fluid which is initially at rest (relative to small surface disturbances) is studied in reference to the phenomenon of the break-up of capillary jets. The stability analysis shows that a jet of a viscoelastic fluid which is characterized by a complex viscosity that is bounded in absolute value is less stable than a jet of a Newtonian fluid of the same zero viscosity. The theoretical results are subsequently evaluated in the light of existing experimental data. Author

N71-17110# Cambridge Univ. (England). Dept. of Engineering.
A THREE-PARAMETER FAMILY OF MEAN VELOCITY PROFILES FOR INCOMPRESSIBLE TURBULENT BOUNDARY LAYERS WITH DISTRIBUTED SUCTION AND SMALL PRESSURE GRADIENT
B. G. J. Thompson London Aeron. Res. Council 1970 49 p refs Supersedes ARC-31145
(ARC-R/M-3622; ARC-31145) Copyright. Avail: NTIS; HMSO: £1.20; BIS: $4.50

An earlier profile family and skin friction law for impermeable surfaces is extended to account for the effects of distributed suction. Accurate skin friction values and reasonable profile shapes are predicted for zero pressure gradient layers on the nylon suction surface, provided that reversion to laminar flow has not started. Charts are presented from which profile shapes can be calculated and local skin friction coefficient values can be obtained. Author (ESRO)

N71-17111# Rheinisch-Westfalische Technische Hochschule, Aachen (West Germany). Inst. fuer Allgemeine Mechanik.
IONIZATION MEASUREMENTS WITH MICROWAVES AND A PULSED LANGMUIR PROBE IN SHOCK HEATED ARGON [IONISATIONSMESSUNG HINTER STOSSWELLEN IN ARGON MITTELS MIKROWELLEN UND EINER GEPULSTEN LANGMUIRSONDE]
Klaus-Peter Schneider and Hans Groenig Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1970 73 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-43) Avail: NTIS; ZLDI Munich: 14,30 DM

The attentuation and phase shifts of 2.5 and 8 mm microwaves were used to study argon ionization behind shocks with Mach numbers from 7 to 12. Rate equation solutions were used to separate the argon ionization and that of the gas impurities. Langmuir probe measurements confirmed the microwave results. Author (ESRO)

N71-17141# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Abteilung Trans- und Ueberschall-Windkanaele.
AN EXPERIMENTAL INVESTIGATION OF TURBULENT SEPARATED BOUNDARY LAYERS AT LOW SUPERSONIC MACH NUMBERS
Robert E. Wilson and Franz Maurer Aug. 1970 43 p refs
(DLR-FB-70-33) Avail: NTIS; ZLDI Munich: 13,40 DM

The results include pressure distributions and schlieren and oil flow photographs. The Mach number dependence of several flow parameters including separation distance in the range 1.25 to 1.75 Mach was studied. Three dimensional effects are described and an accurate flow model is discussed. Author (ESRO)

N71-17142# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.
ON THE MEASUREMENT OF PRESSURE FLUCTUATIONS WITH MICROPHONES INSERTED IN A FREE STREAM [UEBER DIE MESSUNG VON DRUCKSCHWANKUNGEN MIT UMSTROEMTEN MIKROFONEN IM FREISTRAHL]
Helmut V. Fuchs (Ph.D. Thesis - Tech. Univ. Berlin) Jun. 1970 78 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-22) Avail: NTIS; ZLDI Munich: 22 DM

Reliable data for a circular air jet at low Mach numbers can be obtained with suitable probes inserted in the stream. The difference between the fluctuating pressure at the probe stagnation point and the pressure in the flow was studied and a coherent fluctuation field was found on both sides of the turbulent shear layer. This near field was associated with a nearly frozen pattern of sources travelling parallel to the main flow. The linear relation between the pressure fluctuations and axial velocity indicated their wave-like character. Author (ESRO)

N71-17167# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
CONTINUITY EQUATION FOR COMPRESSIBLE FLOWS WITH SMALL DISTURBANCE VELOCITIES [UEBER DIE KONTINUITAETSGLEICHUNG KOMPRESSIBLER STROEMUNGEN BEI KLEINEN STOERGESCHWINDIGKEITEN]
Friedrich Keune Jul. 1970 21 p refs In GERMAN; ENGLISH summary
(DLR-Mitt-70-13) Avail: NTIS; ZLDI Munich: 6,80 DM

The density changes in compressible flows were developed in orders of magnitude of the components of the disturbance flow. If only the linear disturbance velocity component in the streamwise direction was retained, the linearized gasdynamic equation was obtained. The additive second order term of these components yielded the nonlinear parabolic equation for transonic flow. The other small quadratic nonlinear terms gave higher order correction terms in the equations of motion. Author (ESRO)

N71-17179# National Physical Lab., Teddington (England). Aerodynamics Div.
THE RESPONSE OF A TURBULENT BOUNDARY LAYER ON AN INFINITE SWEPT WING TO THE SUDDEN REMOVAL OF PRESSURE GRADIENT
P. Bradshaw (Imperial Coll.) and M. G. Terrell (Rolls-Royce, Ltd., Derby) Oct. 1969 31 p refs
(NPL-AERO-1305; ARC-31514) Copyright. Avail: NTIS

A limited series of measurements showed no appreciable dependence of turbulence structure on moderate three-dimensionality, although large differences between the direction of the shear stress vector and the direction of the velocity gradient vector appeared in the outer layer. Author (ESRO)

N71-17289# Oak Ridge National Lab., Tenn.
INVESTIGATION OF THE NEED FOR VARIABLE ORIFICES IN MULTISTAGE FLASH EVAPORATORS
R. Van Winkle Nov. 1970 67 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2746) Avail: NTIS

The suitability of various devices to regulate flashing brine flow through flash evaporators was reviewed. Plain orifices have little regulating capability. Baffles provide an impedance that decreases as water depth increases and thus offers a degree of brine flow regulation. The relationships involved in regulating fluid flow by the use of baffles have not been described well enough, to date, for use in design. Novel devices, which may provide practical means for flow regulation, include pressurized rubber-fabric dams (Fabridams) and spring-loaded flappers. A computer program, ORFIG, was developed to study perturbations in MSF operation due to changes in parameters such as steam flow, recycle flow, ocean temperature and fouling. The only type of reasonable perturbation which seemed to require variable orifices was turndown, if it is desired to minimize steam consumption in the turned-down condition. Author (NSA)

N71-17326*# City Coll. Research Foundation, New York.
BREAKUP OF A LAMINAR CAPILLARY JET OF A NON-NEWTONIAN FLUID
Michael Goldin (Ph.D. Thesis) 1970 241 p refs
(Grants NGR-33-013-009; NSF GK-11374)
(NASA-CR-116489) Avail: NTIS CSCL 20D

The behavior of capillary jets of nonnewtonian inelastic liquids and of viscoelastic fluids was investigated experimentally. Data were obtained through high speed still photographs and motion pictures taken along the length of the liquid column. The program concentrated on profile decay measurements, which refers to the change in jet diameter with axial distance due to stress relaxation, and on jet breakup studies. The viscoinelastic liquids all possessed yield stresses and were comprised of a wide variety of roganic and inorganic materials. The less gellified fluids formed capillary jets which propagated disturbances in the same manner as for a Newtonian jet, that is, as an exponentially growing wave of constant wave length. Even the most highly gellified fluids could be readily atomized. Author

N71-17394# von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

APPLICATION OF FILM COOLING TO GAS-TURBINE BLADES

C. Liess and J. Carnel *In* AGARD High Temp. Turbines Jan. 1971 11 p refs (See N71-17372 07-28)

Avail: NTIS HC $6.00/MF $0.95

The injection of a secondary flow into a high velocity main stream was investigated. The secondary flow was heated and injected by a row of inclined holes into a main flow of ambient temperature. The geometry of the injection holes and the main flow velocity corresponded to conditions encountered on real turbine blades. After a brief review of the application of film cooling to gas turbine blades the results of the measurements are presented. The tests concerned the adiabatic wall effectiveness and the flow field downstream of the injection holes. The test results show that approximate two-dimensional flow conditions can be obtained not far downstream of the holes, provided that the spacing to diameter ratio of the holes is small. Author

N71-17416*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF DEVELOPING LAMINAR FLOW AND HEAT TRANSFER IN A TUBE FOR A GAS WITH COOLING

Alden F. Presler Washington Feb. 1971 39 p refs

(NASA-TN-D-6152; E-5606) Avail: NTIS CSCL 20D

Numerical solution of the boundary layer equations in the entire flow cross section for monatomic gases gives velocity and temperature profiles, Nusselt numbers, friction factors, and static pressures from the entrance region to nominal fully developed tube lengths. Moderate and high cooling fluxes are investigated. Larger fluxes produce adverse pressure gradients in the downstream tube sections which drastically modify the velocity and temperature profiles and the Nusselt and friction parameters. Rayleigh flow analysis predicts momentum pressure change within 25 percent of boundary layer calculations. Author

N71-17443*# Techtran Corp., Glen Burnie, Md.

FLOW WITH A SEPARATED SHOCK WAVE PAST A WEDGE-SHAPED PROFILE [OBTEKANIYE KLINOVIDNOGO PROFILYA S OTSOEDINENNOY UDARNOY VOLNOY]

V. G. Bukovshin Washington NASA Feb. 1971 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (USSR), no. 2, Mar.–Apr. 1969 p 83–85

(Contract NASw-2037)

(NASA-TT-F-13469) Avail: NTIS CSCL 20D

A supersonic gas flow past a wedge at zero degree angle of attack and with a separated shock wave is analyzed by the integral relations method. Numerical values are given for the velocity gradient at the stagnation point and for distribution of pressure and drag at the wedge at Mach numbers from 3–20 and semiapex angles from 60–85 deg. These values are compared with values obtained by the Newtonian theory and by a modified formula of Newton. The values obtained by the integral relations method for pressure distribution and drag coefficient differ significantly from the values obtained by the Newtonian formulas. The velocity gradient increases with an increase of Mach number and a decrease of the semiapex angle. Author

N71-17444*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

OPTICAL PROBING OF SUPERSONIC AERODYNAMIC TURBULENCE WITH STATISTICAL CORRELATION. PHASE 1: FEASIBILITY

B. H. Funk, Jr. and H. A. Cikanek, Jr. Washington Feb. 1971 143 p refs

(NASA-TN-D-6077; M-165) Avail: NTIS CSCL 20D

The feasibility of measuring statistical properties of supersonic aerodynamic turbulence by statistical correlation of signals remotely retrieved by optical probing without the use of tracers was investigated. Theoretical analyses and qualitative experimental results are presented concerning the application of laser schlieren and laser shadow-correlation remote sensing systems. Cross-correlation measurements made on-line with parallel and crossed beams are shown and discussed. A one-shot statistical correlation concept is introduced and experimentally verified that allows the time-history of the decay of turbulent structures to be computed from a single composite signal and displayed on an oscilloscope while data are being retrieved. Author

N71-17569* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

HEATED ELEMENT FLUID FLOW SENSOR Patent

David Bell, III, inventor (to NASA) Issued 17 Mar. 1970 (Filed 25 Sep. 1968) 4 p Cl. 73-204; Int. Cl. G01f1/00

(NASA-Case-MSC-12084-1; US-Patent-3,500,686; US-Patent-Appl-SN-762438) Avail: US Patent Office CSCL 20D

A flow sensor is described for sensing the fluid flow in a thermal conductive conduit. It includes a pair of spaced-apart thermocouples arranged for thermal contact with axially spaced-apart points on the outside surface of the conduit. A heating element is placed between the thermocouples for heating a portion of the conduit and the adjacent fluid. Electrical sensors are connected to the thermocouples for sensing the flow of fluid in the conduit. Official Gazette of the U.S. Patent Office

N71-17573* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LEAK DETECTOR Patent

Miles L. Lockard, inventor (to NASA) Issued 23 Jun. 1970 (Filed 19 Jun. 1968) 4 p Cl. 73-45.5; Int. Cl. G01m3/08

(NASA-Case-LAR-10323-1; US-Patent-3,516,284; US-Patent-Appl-SN-738314) Avail: US Patent Office CSCL 20D

An apparatus is described which provides detection of fluid leaks in a sealed receptacle without the need for human monitoring of the equipment. The device consists of a container of liquid with a hood partly submerged in the liquid and having a tube extending up from the hood. A vacuum source is incorporated to draw the liquid up into the hood and tube. By placing the specimen fluid receptacle into the liquid and under the hood, bubbles from leaks are collected in the hood and pass into the tube. A transparent section within the tube is monitored by a light source and photocell arrangement to automatically detect the bubble and ascertain the existence of the leak. D.L.G.

N71-17578* Auburn Research Foundation, Inc., Ala.

SHEAR MODULATED FLUID AMPLIFIER Patent

Fabio R. Goldschmied, inventor (to NASA) Issued 14 Jul. 1970 (Filed 30 Jan. 1968) 6 p Cl. 137-81.5; Int. Cl. F15c1/16

Sponsored by NASA

(NASA-Case-MFS-10412; US-Patent-3,520,317; US-Patent-Appl-SN-701635) Avail: US Patent Office CSCL 20D

The fluidic high pressure hydraulic amplifier is composed of a fluidic vortex amplifier as a power stage and a vortex shear modulator as a pilot stage. The vortex amplifier's control stream input is modulated by the vortex shear modulator which has an input of much lower pressure. The modulation is accomplished by the shearing or deflecting effect of the vortex shear modulator on the supply jet within the venting gap between a power nozzle and a jet receiver. The low pressure input of the vortex shear modulator controls the larger pressure of the hydraulic control stream of the vortex amplifier. The amplifier in turn controls the final hydraulic output of the vortex amplifier from zero to a given high pressure. The initial low pressure input may be hydraulic or pneumatic and it may be single or multiple. Official Gazette of the U.S. Patent Office

N71-17579* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOGIC AND GATE FOR FLUID CIRCUITS Patent
Richard F. Hellbaum, inventor (to NASA) Issued 3 Feb. 1970 (Filed 6 May 1968) 4 p Cl. 137-81.5; Int. Cl. F15c1/08
(NASA-Case-XLA-07931; US-Patent-3,493,004;
US-Patent-Appl-SN-726898) Avail: US Patent Office CSCL 20D

A logic AND gate is described which has A and B inputs, each with a pair of outlets and one of each pair joined together to form a common output. Each of the A and B inputs is arranged to produce a wall attachment with a wall for both its outlets, but is also arranged to have a perferential attachment to a wall of its unconnected outlet. The A and B inputs are connected to directly impinge on each other in a direction tending to produce shift of each input signal from its preferred to its joined outlet, thus yielding a nonproportional AND output. Cross venting of the output chambers results in outputs insensitive to load.
Official Gazette of the U.S. Patent Office

N71-17630 California Univ., Los Angeles.
SOME EFFECTS OF GRAVITATIONAL TIDES ON A ROTATING FLUID
Steven Tyler Suess (Ph.D. Thesis) 1969 147 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-2264

The effects of gravitational body tides on the dynamics of a fluid core are investigated in an earth model. This is done in a complete earth-moon system with laminar and nonhydromagnetic flow. The tiltover angle between the angular velocity vector of the core and the angular velocity vector of the mantle is found, and its role in the motion of the core is discussed. A boundary layer analysis shows the linear viscous modification of the flow, and an extension to second order effects shows how the nonlinear interaction dominates the interior motion. Tiltover, its implied second order interior flow, and the interior second order flow due to the semi-diurnal nature of the tide are the main results of the study. Tiltover, interior tide-driven motions, and interior tiltover-driven motions in a deformable fluid-filled container are measured.
Dissert. Abstr.

N71-17631* Rocketdyne, Canoga Park, Calif.
LAMINAR FLOW ENHANCEMENT Patent
Ralph A. Ayvazian, inventor (to NASA) Issued 20 Oct. 1970 (Filed 6 Mar. 1968) 5 p Cl. 60-217; Int. Cl. F02k9/00; Int. Cl. F17d1/16; Int. Cl. R01f17/42 Sponsored by NASA
(NASA-Case-NPO-10122; US-Patent-3,534,555;
US-Patent-Appl-SN-710949) Avail: US Patent Office CSCL 20D

A method for improving the laminar flow of liquid coolants in rocket engines is presented. This method comprises reducing the fluid flow friction losses through addition of a surface active agent, either directly to the liquid or by coating the chamber walls.
Official Gazette of the U.S. Patent Office

N71-17640 California Univ., Los Angeles.
THE STEADY-STATE RESPONSE OF CONTAINED ROTATING, ELECTRICALLY CONDUCTING, VISCOUS FLUID SUBJECT TO PRECESSIONAL AND LORENTZ FORCES, AND ITS IMPLICATIONS REGARDING GEOMAGNETISM
Roger Frederick Gans (Ph.D. Thesis) 1969 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-2203

When a rotating spheroid is precessed about an axis in space, the first order response of a contained fluid of small viscosity is known to be a tilt of the rotation axis of the main part of the fluid with respect to the container. The magnitude of this tilt is governed by the balance of the precession forces against the pressure forces caused by the oblateness, and the viscous forces resulting from flow in and out of the (Ekman) boundary layers. The boundary layer structure resulting from the addition of an axial magnetic field is deduced, and the resulting modification in tilt caused by the distortion of field lines in magnetic boundary layers is found. A formal analogy between spheroidal and cylindrical containers is demonstrated by constructing the boundary layer solution for the cylinder. An experimental program using liquid sodium in a cylindrical container and capable of extending information beyond the range of validity of the theory is described, and the results of the first experiments, which bear on the linear theory, are given.
Dissert. Abstr.

N71-17646 Alabama Univ., University.
A THEORETICAL STUDY OF THE INTERACTION OF SONIC TRANSVERSE JETS WITH SUPERSONIC EXTERNAL FLOWS
Che-Ching Lee (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-1392

A theoretical method is presented for the determination of the two-dimensional flow field in the vicinity of the injection port of a secondary sonic jet normal to a supersonic external stream. The solution is valid for flows in which the boundary layer is of negligible thickness and mixing effects can be neglected. The gas is assumed to be perfect and inviscid. The method of characteristics was employed in the determination of the jet flow field; and the time-dependent finite-difference method was employed to determine the external flow field. The key to the over-all solution lies in coupling the flow fields through the jet boundary. This is accomplished by constraining the static pressure to be continuous across the jet boundary. Extensive calculations were carried out to study the effect of free stream Mach number, jet total pressure and injectant gas composition on penetration, shock stand-off distance, and upstream pressure distribution. The results of these theoretical calculations were compared to the published experimental data and correct qualitative trends were obtained.
Dissert. Abstr.

N71-17661* Hughes Aircraft Co., Los Angeles, Calif.
GAS REGULATOR Patent
Harry J. King and Seiji Kami, inventors (to NASA) Issued 20 Oct. 1970 (Filed 18 Jul. 1968) 6 p Cl. 137-341; Int. Cl. F16k49/00 Sponsored by NASA
(NASA-Case-NPO-10298; US-Patent-3,534,765;
US-Patent-Appl-SN-745852) Avail: US Patent Office CSCL 20D

Pressurized gas flow control from a container by a suitable metal plug is described. The plug is disposed into the outlet of the pressurized vessel and subjected to controlled heating to increase the amount of diffusion gas flow. Either a heatable plenum chamber connected to the outlet of the heated plug provides gas pulses for feeding the pressurized fluid line, or the outlet from the plugged pressurized vessel is used to control a positive expulsion liquid reservoir.
Official Gazette of the U.S. Patent Office

N71-17674 Stanford Univ., Calif.
THE COLLISIONLESS SOLUTION OF THE KINETIC PROBLEM FOR RAREFIED FLOW PAST A CONE
James Parker Elliott (Ph.D. Thesis) 1969 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-1523

The general kinetic problem for the collisionless flow of a neutral, monatomic, unexcited gas past a convex body is considered. The solution to the governing kinetic equation for the time-independent problem in the absence of external forces is obtained by the method of characteristics. The distribution function is specified by boundary conditions in the free stream and at the surface of the body. The latter condition incorporates both the

geometry of the body and the details of the gas-solid interaction, which is assumed to be either specular or diffuse in nature. In the free stream, a condition of thermodynamic equilibrium is assumed. The details of the complete solution are carried out for the particular case of flow past a right circular cone at zero angle of attack with the free stream. For convenience, only a diffuse interaction is considered in this case. The surface temperature is assumed to be constant. Dissert. Abstr.

N71-17677*# United Technology Center, Sunnyvale, Calif.
DETERMINATION OF THE EFFECTS OF LIQUID INJECTANTS ON NOZZLE ABLATIVE PERFORMANCE Final Report
L. G. Ross and C. A. Le Febvre 31 Dec. 1970 153 p
(Contract NAS3-13304)
(NASA-CR-72792; UTC-2359) Avail: NTIS CSCL 20D

Four candidate low-cost nozzle materials and a standard material were tested with two liquid injectants to determine liquid injectant thrust vector control ablation performance. Ten motor firings were conducted, utilizing a 3.5-in. (0.089 m) throat diameter with average chamber pressures of 600 and 700 psia. Conclusions are that the low cost silicas, double thickness and vacuum bag cured, perform similarly to the higher cost standard material and are suitable for both thrust vector control (TVC) and non-TVC affected areas. Liquid injection with low-cost materials, other than silica-based materials, increases the ablation severely to the point of non-use in TVC areas. In non-TVC areas, the materials also show greater ablation at the higher test pressures due to the increased heat flux. The nonsilica-based materials are only suitable for greater expansion area ratios well downstream of injectant effects and at lower heat fluxes. Author

N71-17689 California Inst. of Tech., Pasadena.
THE ROTATION OF A GRAVITATING SPHERE IN A MONATOMIC GAS, 1. THE DRAG OF A BODY MOVING TRANSVERSELY IN A CONFINED STRATIFIED FLUID, 2
Michael Ralph Foster (Ph.D. Thesis) 1969 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-547

The flow resulting from the steady rotation of a gravitating sphere in a monatomic gas at rest is studied. The low speed rotation problem involves the solution of nonuniform Stokes equations. The high speed rotation case is considered, and solutions are obtained only for a gas with small Prandtl number. The motion of a body through a stratified fluid bounded by vertical plates is studied when the motion of the body is sufficiently slow to make the inertia of the fluid negligible. The density changes are large, and the drag is easily computed, depending only on changes of potential energy of the fluid. The solution exhibits regions where the fluid is unstably stratified, and hence mixes. The equations for boundary layers are given. Dissert. Abstr.

N71-17698 Alabama Univ., University.
ANALYSIS OF BOW SHOCK STRUCTURE AT A STAGNATION POINT SUBJECTED TO EXTERNAL RADIATION
Julius Quentin Lilly (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-1393

The effects of external source radiation on the viscous hypersonic shock layer are investigated. The conservation equations are obtained for a viscous, hypersonic, radiating stagnation region flow. The radiative heat flux is obtained for the plane parallel slab approximation considering emission and absorption of radiation in the shock layer. A two-step model approximation to the spectral absorption coefficient of air is developed from detailed spectral data and used in this investigation. Real gas thermodynamic and transport properties are utilized in the form of correlation equations. The Lees–Dorodnitsyn transformations are used to transform the conservation equations, then a similarity solution is obtained using a fourth-order Runge–Kutta iterative procedure. Comparison of solutions with previous radiating and nonradiating stagnation heating results are presented. Dissert. Abstr.

N71-17737# Bowles Fluidics Corp., Silver Spring, Md.
ENGINEERING STUDY OF AN ELECTRO-FLUID CONVERTER CONCEPT Final Report
Larry R. Moore and Robert F. Turek Jun. 1970 67 p refs
(Contract N00014-69-C-0328)
(AD-715102; R-6-30-70) Avail: NTIS CSCL 13/7

The feasibility of a direct electro-fluid signal conversion transducer using the interaction of fluid dielectric properties with non-uniform electric fields is investigated. An analysis of the electrostrictive pressures produced by polarization gases in an electric field gradient is presented. Test results of several jet-electrode configurations using air as the working fluid are also presented. Relatively high potentials, generally greater than 1000 volts, were required to produce measurable results by electrostrictive forces. In some tests, unintentional ionization produced an action before the dielectric induced forces could be observed. The most promising configuration for using electrostrictive forces is a wall interaction fluidic element with multiple electrodes in one wall. Author (GRA)

N71-17738# Naval Ordnance Lab., White Oak, Md.
TWO-DIMENSIONAL JET INTERACTION WITH A MACH 4 MAINSTREAM
Richard T. Driftmyer, David G. Shaffer, and Michael J. Werle 1 May 1970 148 p refs
(AD-715104; NOLTR-70-50) Avail: NTIS CSCL 20/4

The report describes the results of an experimental study concerning the injection of a gaseous secondary jet into an unbounded supersonic flow field which was uniform outside of a turbulent boundary layer. The investigation was principally concerned with the definition of the proper scale length to be associated with turbulent two-dimensional jet-interaction flows. In support of this objective, results are presented for a Mach 4 test conducted using a flat-plate model containing a sonic secondary jet directed normal to the mainstream. Secondary jet strengths were varied from approximately 0 to 1000 for jet throat sizes of 0.005 inch, 0.020 inch and 0.030 inch. The jet interaction phenomenon was studied using detailed surface pressure distributions measured fore and aft of the secondary jet in conjunction with comprehensive shadowgraph coverage of the interaction flow field. Author (GRA)

N71-17743# Colorado State Univ., Fort Collins. Fluid Mechanics Program.
THE SPECTRUM OF ENERGY IN TURBULENT SHEAR FLOW
D. M. Kesic, J. E. Carmak, and S. Panchev Sep. 1970 113 p refs
(Contract N00014-68-A-0493-0001)
(AD-714856; CER69-70DMK-JEC-SP-9; THEMIS-TR-5) Avail: NTIS CSCL 20/4

The spectrum of energy in isothermal turbulent shear flow at large wave numbers is studied following the phenomenological approach used by Tchen (1953), Hinze (1959), and Panchev (1968, 1969). The considered spectrum equation consists of the dissipation, the transfer, the production, and the diffusion spectrum function. Parametric solutions for the three-dimensional energy spectrum function E(k) are obtained firstly by using Heisenbergs type of approximations for the transfer function. Much simpler solutions for E(k) are obtained with the modified Obukhov approximation (Ellison 1962). Some closed form solutions for E(k) are derived by

using a vorticity approximation concept. It is shown that Tchens 1/k law cannot exist if diffusional effects are taken into account. Computed one-dimensional energy spectra (isotropic relations were used) show good agreement with measurements from the viscous region of a turbulent boundary layer. Author (GRA)

N71-17752 California Inst. of Tech., Pasadena.
THE HYPERSONIC LAMINAR BOUNDARY LAYER NEAR A SHARP EXPANSION CORNER
Keith Jordis Victoria (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-1426

The integral moment method for treating interactions between a laminar boundary layer and an external supersonic flow is applied to the problem of the hypersonic laminar boundary layer near sharp and slightly rounded convex (expansion) corners. The general features of this type of interacting flow are established by an analytical solution of the integral equations using the method of matched asymptotic expansions for the case of small interaction parameter. Numerical solutions are obtained for flows for which the interaction parameter can no longer be considered small. An experimental study is carried out in the GALCIT Mach 8 hypersonic wind tunnel in order to study the two-dimensional laminar boundary layer expansion. Major emphasis is placed on the acquisition of detailed data near the corner region. The basic measurements consist of the model surface pressure distribution and pitot pressure surveys of the boundary layer and inviscid flow field between the boundary layer and the leading edge shock wave both upstream and downstream of the corner region. The surface pressure measurements illustrate the striking departure of the flow field at hypersonic speeds from the classical Prandtl-Meyer description. Dissert. Abstr.

N71-17760 IIT Research Inst., Chicago, Ill.
HYPERBOLIC ALIGNED MAGNETO-GASDYNAMIC FLOW OVER A CONE
Lee Alfred Bertram (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-1095

Steady, dissipationless, aligned field flow of a perfect gas over axisymmetric nonconducting bodies is examined for flow conditions such that the Alfven number A and Mach number M are in the regions (A > or = 1, M > or = 1) or (A sq + M sq > = 1, A < or = 1, M < or = 1). In these ranges the equations of motion possess real characteristics, and the shock relations have solutions which satisfy the second law of thermodynamics and are stable against one dimensional breakup criterion. Shock waves are found to be of three basic types. (1) Weak field: Shock waves behave in qualitatively the same manner as in gas dynamics, but can tolerate larger turning angles with increasing field strength. (2) Strong field: Field strength is so great that maximum turning angle decreases again. (3) Sub-Alfvenic flow: Stable shock solutions are those lying on shock surfaces making obtuse angles with the upstream flow direction. Families of shock polars for each of these regions are presented. The axisymmetric flows corresponding to each of these shock types are studied by both numerical integration of the exact equations of motion and by perturbation solution carried out to second order. Dissert. Abstr.

N71-17761 California Univ., Los Angeles.
NUMERICAL STUDIES OF SUPERSONIC NEAR-WAKES
Leonard Walitt (Ph.D. Thesis) 1969 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-2274

A numerical investigation was conducted of the flow field about a right circular cylinder immersed in a Mach 2.0 airstream. The Reynolds number of this flow was 1409 based on the diameter of the cylinder. A computer code which solves the time-dependent Navier-Stokes equations for a compressible, heat conducting fluid was used for the numerical computations. Steady state was approached as an asymptote of the time dependent solution. Convergence of the numerical solutions obtained was demonstrated with two different finite difference meshes, both of which provided unusually large mesh point densities. The pressure and internal energy fields in the neighborhood of the cylinder and in the wake of the body, differed by no more than a few percent in the two cases. Dissert. Abstr.

N71-17786# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.
NONLINEAR PERIODIC WAVES IN A BOUNDED MEDIUM: A REGULAR PERTURBATION APPROACH
Michael P. Mortell Oct. 1970 30 p refs
(Contract DAAD05-69-C-0053)
(AD-714997; CAM-110-10; BRL-CR-14) Avail: NTIS CSCL 12/1

A regular perturbation scheme is given for calculating small amplitude nonlinear periodic waves in a medium of finite extent. The first term in the asymptotic expansion is an arbitrary linear standing wave. The signal carried by the waves is determined from the nonlinear terms in the governing equations by an application of the Fredholm alternative. This gives a systematic scheme for calculating the corrections to the basic flow. The first problem considered is the resonant forced motion of a polytropic gas contained in a tube with its end closed. The second problem concerns the free vibration of an anharmonic lattice, or a nonlinear dispersive string. Author (GRA)

N71-17787# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
BASE FLOW ANALYSIS OF AN AXISYMMETRIC BODY WITH A CENTRAL JET, MAY 1969–MARCH 1970
Y. S. Hong 20 Nov. 1970 75 p refs
(Contract F04701-70-C-0059)
(AD-715258; TR-0059(6154-03)-1; SAMSO-TR-70-415) Avail: NTIS CSCL 20/4

A method of predicting the base flow of an axially-symmetric cylindrical vehicle with a single central jet issuing from the base was developed with the application of Korsts two-stream interaction model. Some of the flow variables that can be estimated by this method are the base pressure, the average base gas temperature, and the entrainment rate of the ambient air into the base region. Effects of other variables such as vehicle and nozzle geometry, engine operating conditions, vehicle Mach number and trajectory, gas properties, base mass, and energy bleed can also be investigated systematically. The results obtained by the present method agree well with Thor flight data as well as available wind tunnel data. The method is limited to a case where the mixing layer is fully turbulent and both the external freestream and the central jet stream are supersonic. Author (GRA)

N71-17795# Aerospace Corp., San Bernardino, Calif. Technology Div.
VORTICAL SHOCK LAYER STAGNATION-POINT FLOW Technical Report, Oct. 1969–Jan. 1970
Rudolph J. Swigart 30 Nov. 1970 35 p refs
(Contract F04701-70-C-0059)
(AD-715263; TR-0059(S6820)-1; SAMSO-TR-70-399) Avail: NTIS CSCL 20/4

Two solutions to the problem of the nature of the inviscid rotational flow in the neighborhood of a general three-dimensional stagnation point have appeared in the literature, one by Hayes in 1964 and the other by Waldman in 1965. Hayes predicts a stagnation streamline coming in tangent to the body in general, with the lateral vorticity becoming infinite at the wall, whereas Waldmans

solution results in a stagnation streamline that is normal to the body with the vorticity identically zero. The question of which solution, if either, is correct in the context of a vortical shock-layer flow containing a plane of symmetry is investigated by formulating the problem in terms of a pair of stream functions and delineating the conditions for recovery of each of the above-mentioned solutions. Based on previous work on the three-dimensional hypersonic blunt-body problem, it is shown that Waldmans solutions cannot apply in the context of a vortical shock-layer flow. Hayes solution is shown to be compatible with the shock-wave boundary conditions, and certain constants in his solution are identified with shock-wave and stagnation-point parameters. Hayes solution, then, is the correct one. However, the shape of the stagnation streamline depends on certain undetermined constants in Hayes solution, being tangent to the body if these constants are finite, and normal to the body if the constants are zero. Whereas the numerical results and experimental results of Xerikos and Anderson indicate the constants to be zero, the experimental results of Zubkov and Glagolev indicate them to be finite. Author (GRA)

N71-17796# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.

SUPERCRITICAL FLOW IN AN OVERFALL

Arthur S. Peters Sep. 1970 52 p refs

(Contract N00014-67-A-0467-0016)

(AD-715067; IMM-384) Avail: NTIS CSCL 20/4

The report presents an analysis of supercritical flow in an overfall whose nappes are subjected to different constant pressures. It contains computations for brink depth and approximate equations for the nappes in the neighborhood of the brink and far downstream. Author (GRA)

N71-17862# Massachusetts Inst. of Tech., Cambridge. Dept. of Naval Architecture and Marine Engineering.

A SEMIAUTOMATED WAKE SURVEY AND ANALYSIS SYSTEM APPLIED TO SMALL MODELS

Neal A. Brown and Jens P. Tjoenneland 28 Jan. 1970 137 p refs

(Contract Nonr-3963(08))

(AD-715098; Rept-70-1) Avail: NTIS CSCL 13/10

A semi-automated wake survey and data analysis system is described. This system was developed to satisfy the modern needs of the propeller specialist, overcoming the shortcomings of the traditional methods. The salient features of this system are electro-mechanical sensing of pressures from a pitot tube probe continuously sweeping in a circular path about the propeller shaft, electronic recording of pressure signals, analog to digital conversion of data and computer analysis yielding velocity vector, harmonic analysis, and velocity and harmonic statistics. Instead of measurements of the wake velocity vector at a small set of discrete points in space, the sweeping probe allows the electronic recording of a continuous spacial sampling of the wake field at any given radius. The high spatial resolution attainable by analog-to-digital sampling makes possible the accurate determination of wake harmonics to high orders. Author (GRA)

N71-17958*# Pratt and Whitney Aircraft, East Hartford, Conn.

AERODYNAMIC BROADBAND NOISE MECHANISMS APPLICABLE TO AXIAL COMPRESSORS

Robert A. Arnoldi Washington NASA Mar. 1971 46 p refs

(Contract NASw-1908)

(NASA-CR-1743; PWA-3930) Avail: NTIS CSCL 21E

A study of broadband noise produced by the interactions of turbulence with the shock system upstream of a supersonic compressor and with the surface of the rotor blade has been made. The dynamic response of the rotor blade in the latter interaction was constructed empirically, based on the results of a complementary experimental program. This program obtained the lift response of an instrumented airfoil subjected to periodic upwash fluctuations. Both source mechanisms are found to produce noise levels of significant magnitude; either might be a prime source of broadband engine noise, and further study of both is recommended. The effect of incidence past stall on the unsteady response is shown to be a small reduction in magnitude and a slowly increasing delay in phase, neither of which make any substantial modifications in predicted noise output. This result was measured at a reduced frequency of 3.9; further investigations over a wider range is recommended. Author

N71-18029*# New York Univ., N.Y.

DIFFRACTION OF A PULSE BY A THREE-DIMENSIONAL CORNER

Lu Ting and Fanny Kung Washington NASA Mar. 1971 92 p refs

(Grant NGL-33-016-119)

(NASA-CR-1728; NYU-AA-70-06) Avail: NTIS CSCL 20D

For the diffraction of a pulse by a three-dimensional corner, the solution is conical in three variables zeta = r/(Ct), theta and alpha. The three-dimensionaleffect is confined inside the unit sphere zeta = 1, with the vertex of the corner as the center. The boundary data on the unit sphere is provided by the appropriate solutions for the diffraction of a pulse by a two-dimensional wedge. The solution exterior to the corner and inside the unit sphere is constructed by the separation of the variable zeta from theta and alpha. The associated eigenvalue problem is subjected to the differential equation in potential theory with an irregular boundary in theta - eta plane. A systematic procedure is presented such that the eigenvalue problem is reduced to that of a system of linear algebraic equations. Numerical results for the eigenvalues and functions are obtained and applied to construct the conical solution for the diffraction of a plane pulse. For the diffraction of a general incident wave by corners or edges, two theorems are presented so that the value at the vertex of the corner or along the edges can be determined without the construction of the three-dimensional nonconical diffraction solutions. Relevant numerical programs for the analysis are presented in the appendix. Author

13 GEOPHYSICS

Includes seronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N71-16920# Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 244 15 Jan. 1971 p 19-28 refs (See N71-16917 07-30)

Avail: NTIS

News briefs and abstracts of scientific articles are presented on Soviet research ships, infrared aerial survey for studying ice cover, stereophotogrammetric unit for underwater photography, the onset of convection in a fluid near the density inversion temperature, rationalization of hydrological observations in the North Sea, mesostructure of geostrophic currents in the open ocean, orientation of rift valleys in mid-oceanic ridges, continuous seismic profiling in the ocean, stepped structure of temperature inversions in the ocean, variability of position of the Gulf Stream front, diurnal oxygen regime in tropical Atlantic waters, components of external heat balance of the oceans, variability of wind and thermohaline currents in the North Atlantic, and structure of wind velocity field over the ocean. R.B.

N71-16921# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 244 15 Jan. 1971 p 29–47 refs (See N71-16917 07-30)
Avail: NTIS

Selected news items and abstracts of articles are presented on the following topics: quartz magnetometer for measuring magnetic declination and horizontal component, petroleum and gas deposits in the seas and oceans, methods for hydromagnetic surveys, using telemetry methods to receive seismic signals, elastic waves and temperature beneath Moho, acoustic efficiency of explosive sound sources, the seismic effect of tropical cyclones, seismoacoustic investigations in the Caspian Sea, geoelectric characteristics of crust and upper mantle, seismicity and deep structure of island arcs, deep seismic sounding of Sakhalin Island, relationship between earthquakes and electric fields, temporal variations in conductivity, phenomena preceding a powerful geomagnetic storm, depth of magnetic anomaly sources in Atlantic rift zone, linear magnetic anomalies in Arctic, and tectonic structure of eastern part of Sea of Okhotsk. R.B.

N71-16922# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 244 15 Jan. 1971 p 48–80 refs (See N71-16922 07-30)
Avail: NTIS

News briefs and abstracts of scientific articles are presented on the following topics: operations of Lunokhod 1 on lunar surface, activity of Venera 7 spacecraft, operation of Bilibino Orbita receiving station, ion composition of atmosphere at 100 to 200 km, vertical movements in lower ionosphere, four orientations of auroral arcs, longitudinal drift of dawn choruses, generation of ionosonic waves in space, inhomogeneous structure of ionosphere, accuracy in approximating satellite geomagnetic measurements, auroras and ionospheric disturbances during solar activity cycle, absorption of X-radiation in earth's atmosphere, and photometric analysis of photos of daytime horizon. R.B.

N71-16930# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON ENERGY LIBERATION MECHANISMS OF POWERFUL AURORAE
V. I. Krasovskii [1970] 10 p refs Transl. into ENGLISH from Kosmich. Issled., Akad. Nauk SSSR (Moscow), v. 8, no. 5, 1970 p 720–727
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

It is shown that besides the energy brought by the solar wind a part of the energy of charged particles of auroras is drawn from the energy of earth's rotation and atmospheric circulation, and then the electrical currents emerging in the ionosphere perform mechanical work. Because of this work, infrasound is generated which assures heating of the upper atmosphere, and also the appearance of its associated emission of 6300 A atomic oxygen. Depending on the character of the circulation of the atmosphere, it can both hinder and contribute to the origination of powerful auroras. Author

N71-16931# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF GEOACTIVE CORPUSCLES AND PHOTO-ELECTRONS ON THE KOSMOS-261
A. D. Boliunova et al [1970] 6 p Transl. into ENGLISH from Kosmich. Issled., (Moscow), v. 8, no. 1, 1970 p 104–108
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A complex experiment to investigate geoactive, low-energy, corpuscles and virgin photoelectrons and their interaction with earth's upper atmosphere is described briefly. This experiment included coordination measurements of geoactive corpuscles from the Cosmos-261 and ground-based observations of the diverse geophysical phenomena. Author

N71-16932# Lockheed Missiles and Space Co., Palo Alto, Calif.
THE ELECTRICAL FIELD EXCITED IN AIR BY A GAMMA QUANTA PULSE
Iu. A. Medvedev et al [1970] 6 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 4, 1970 p 3–8
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Characteristics of the electrical field due to polarization of air during the progress of nonstationary Compton currents excited by a gamma-quanta pulse in low density air are examined. The influence of the field on the motion of the Compton electrons is taken into account. The field amplitude and relaxation time are estimated. Author

N71-16933# Lockheed Missiles and Space Co., Palo Alto, Calif.
ROCKETS AID INVESTIGATION OF THE ATMOSPHERE
L. Lvov [1970] 2 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 7, 1970 p 39
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A brief review is given of the use of Soviet rockets for atmospheric sounding since 1951. The meteorological rockets MR-1 and MR-12, the ship-launched M-100, and the geophysical rockets of the A-1 type are mentioned as firsts in their respective fields. It is pointed out that during IGY the USSR launched 112 meteorological and 13 geophysical rockets. N.E.N.

N71-16934# Lockheed Missiles and Space Co., Palo Alto, Calif.
NITRIC OXIDE AT 100-200 km ALTITUDES FROM COSMOS 224 SATELLITE DATA
V. A. Krasnopolskii [1970] 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 10, no. 5, 1970 p 837–841
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A vertical profile of NO was obtained for low sun zenith angles. Data from the experiment are compared with the computed NO profile obtained with O2(1 Delta) taking part. Good agreement between experiment and computation is observed in the whole domain, with the exception of the 110 to 150 km altitude band. Reasons for the discrepancies at these altitudes are discussed. Author

N71-16947# Lockheed Missiles and Space Co., Palo Alto, Calif.
RATE OF ORDERED ION MOTION IN THE IONOSPHERE AT A 600 km ALTITUDE. 1: METHOD OF MEASUREMENT
V. N. Ponomarev et al [1970] 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 8, no. 4, 1970 p 557–562
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A method is described for measuring the ordered motion velocity of ions in the ionosphere by using an ion sensor mounted on the Cosmos 184. A description of the instrument is given, and its application to measure the velocity of ions as well as to determine their concentration is shown. Author

N71-16948# Lockheed Missiles and Space Co., Palo Alto, Calif.
VELOCITY OF ORDERED ION MOTION IN THE

IONOSPHERE AT 600 km ALTITUDE. 2: EXPERIMENTAL RESULTS

V. N. Ponomarev [1970] 10 p refs Transl. into ENGLISH from Kosmich. Issled (Moscow), v. 8, no. 4, 1970 p 563–570
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Measurements of the velocity of ordered ion motion in the ionosphere at a 600 km altitude are presented. The results were obtained by using an ion transducer during the flight of the Cosmos 184 in November–December 1967. Maps of the distribution of the magnitudes of the vertical and horizontal ion displacement velocity components relative to the satellite orbit plane and the same ion drift velocity components relative to earth's surface were obtained. A qualitative explanation is given for the data. Author

N71-16958# Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 242 15 Dec. 1970 p 13–17 refs (See N71-16955 07-30)
Avail: NTIS

News items and research reports on the following topics are summarized: noise immunity of vertical gradient waves, voyage of the research vessel VITYAZ, geological structure of Sakhalin Island shelf, measuring vertical gravity gradient at sea, deep seismic sounding at sea, surface water temperature measurements in the North Atlantic, upper layer thermal processes in Kuroshio current, heat exchange and convection in the Arctic Sea, the upper isothermal water layer in the North Atlantic, and seismoacoustics of shallow sea sediments. E.C.

N71-16959# Joint Publications Research Service, Washington, D.C.

TERRESTRIAL GEOPHYSICS

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 242 15 Dec. 1970 p 18–24 refs (See N71-16955 07-30)
Avail: NTIS

News items and research reports on the following topics are summarized: seismic detector configuration, borehole instrument for vertical seismic profiling, processing device for continuous seismic observation data, elastic oscillation excitation apparatus, borehole gravimeter, earth magnetic field structure in the oceans, anomalous magnetic field in the U.S.S.R., temporal earth magnetic field variations, anomalous magnetic field over oceans and continents, quantitative interpretation of travel-time curves for earthquake or remote explosion waves, and recording long range industrial explosions using standard refracted waves and deep seismic sounding stations. E.C.

N71-16960# Joint Publications Research Service, Washington, D.C.

UPPER ATMOSPHERE AND SPACE RESEARCH

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 242 15 Dec. 1970 p 25–54 refs (See N71-16955 07-30)
Avail: NTIS

News items and research reports are summarized with emphasis on the flight of the Luna 17 spacecraft and operations of the Lunokhod remote controlled lunar surface vehicle. Other materials contain information on the Soyuz 9 flight, the recovery of Zond 8, trajectory correction of Venera 7, and the launching of Cosmos satellites 377 and 378; as well as investigations of the F1 region daytime electron concentration, F2 region ionization, ionospheric electron wave disturbances, ionospheric movements at different altitudes, interplanetary medium characteristics during geomagnetic storms, the distance of the magnetospheric boundary subpolar point, a charge and direction detector for high energy particles, recording solar protons from chromospheric flares, ionization drift in F region during magnetic disturbances, and ion and electron structure of the daytime F1 region. E.C.

N71-16994# Geological Survey, Arlington, Va.

ATLANTIC REGION SEMIANALYTICAL AEROTRIANGULATION PROGRAM

Leonard R. Mannello, Morris L. McKenzie, and Robert Montgomery, Jr. Apr. 1970 68 p refs *Its* Computer Contrib-6
(PB-194570) Avail: NTIS CSCL 08B

The program joins units of horizontal and/or vertical pass points to each other and to ground control, simultaneously, forming a block of adjusted coordinates. Transformation parameters for the adjustment are determined by the method of least squares. Ground coordinate values are computed for all tie points and any additional points for which instrument coordinates were read. The program user can specify first- or second-degree horizontal adjustment with or without a vertical adjustment and with or without punched-card output. The punched card output format can be specified for either Autoplot (automatic plotter) input or input for subsequent block adjustments. Author (GRA)

N71-16995# Texas A&M Univ., College Station. Coastal and Ocean Engineering Div.

A COMPUTER PROGRAM TO ESTIMATE THE COMBINED EFFECT OF REFRACTION AND DIFFRACTION OF WATER WAVES Final Technical Report

Henry W. Worthington (M.S. Thesis) and John B. Herbich Aug. 1970 66 p refs Supported in part by the Chicago Bridge and Iron Co., Oak Brook, Ill.
(Grant NSF GH-59)
(PB-194668; TAMU-SG-70-219; COE-127) Avail: NTIS CSCL 08C

The phenomena which generally affect water waves entering a harbor are reviewed and traditional methods of calculating the effects of refraction, diffraction, and shoaling are discussed. The capability of the computer to make the required calculations is illustrated. A computer program is presented which estimates the effects of refraction and diffraction as they combine to change the direction and height of water waves. A feature of the program is that it considers the degree of reflection from the breakwater in calculating the diffraction coefficients. The validity of the predicted results is established by comparing them to experimental data. Applications of the program to design and analysis problems are discussed. Author (GRA)

N71-16998# National Air Pollution Control Administration, Durham, N.C. Div. of Abatement.

CHATTANOOGA, TENNESSEE/ROSSVILLE, GEORGIA INTERSTATE AIR QUALITY STUDY, 1967–1968

Grady T. Helms, James H. Southerland, Kenneth R. Woodward, Ibrahim J. Hindawi, Dale H. Coventry et al. Oct. 1970 122 p refs
(PB-195145; APTD-0583) Avail: NTIS CSCL 13B

In 1965, the ammunition plant at Tyner, Tennessee was reactivated. Shortly thereafter complaints of particulate and gaseous emissions were received by governmental officials from citizens in the area. On October 1, 1967, an air quality survey was begun in the Chattanooga, Tennessee - Rossville, Georgia, interstate area. Four other investigations were conducted in the area from October 1967 through April 1969: (1) meteorological measurements; (2) vegetation effects measurements; (3) materials effects studies; and (4) emission survey. Author (USGRDR)

N71-16997# Edgerton, Germeshausen, and Grier, Inc., Albuquerque, N.Mex.

SOME ANALYSIS RELATING TO THE SECEDE 3 BARIUM RELEASE MISSIONS
Jeff Colvin 5 Oct. 1970 58 p Prepared for Los Alamos Sci. Lab.
(Contract AT(29-1)-1183)
(EGG-1183-3007) Avail: NTIS

The analyses and software that were developed in support of the scientific objectives of the SECEDE 3 high-altitude barium release missions are discussed. Cameras aboard the LASL NC-135 aircraft took photographs of the barium-ion cloud as it moved in the geomagnetic and electric fields of the ionosphere. In particular, equations are developed for (1) the position and orientation of the aircraft as a function of time, (2) the cloud position as a function of time, (3) the geomagnetic field vector at the cloud's center, (4) the sunline vector at the cloud's center, and (5) the projection of these two vectors into the plane of the film on which the cloud is photographically recorded. The FORTRAN computer program developed to do these calculations is documented. Author (NSA)

N71-16999# Mobile County Board of Health, Ala.
SOUTH ALABAMA REGIONAL AIR POLLUTION STUDY, 1970. STUDY OF THE AMBIENT AIR QUALITY AND POLLUTION POTENTIAL OF BALDWIN, ESCAMBIA AND MOBILE COUNTIES
James Fibbe Apr. 1970 53 p refs Sponsored in part by HUD Prepared for S. Ala. Regional Planning Comm.
(PB-194874) Avail: NTIS CSCL 13B

The general factors and effects of air pollution, levels of pollution, and the probable sources are considered. The present laws and the needs for future changes in the law are discussed. Conclusions regarding the total air pollution picture are drawn and recommendations for future action are provided. Author (GRA)

N71-17000# National Air Pollution Control Administration, Raleigh, N.C.
KANAWHA VALLEY AIR POLLUTION STUDY
Mar. 1970 371 p refs Prepared in cooperation with W. Va. Air Pollution Control Comm.
(PB-194881; APTD-70-1) Avail: NTIS CSCL 13B

The joint study was conducted from August 1964 through December 1966 and included: (1) measurement of air quality; (2) measurement and description of meteorological parameters; (3) odor studies; (4) collection and evaluation of existing information; (5) pollutant emission inventory; (6) study of materials deterioration; (7) study of means and economics of pollution control; and (8) special studies on vegetation, health, public attitudes, and pollutants not routinely measured. The results of the first seven activities are included. Preliminary results of the studies in vegetation, health and attitudes were considered in developing the Air Resource Management Program. Author

N71-17045# European Space Research Inst., Frascati (Italy).
ADMITTANCE OF RF PROBES IN A SIMULATED IONOSPHERE
T. A. Hall and G. Landauer [1970] 34 p refs Submitted for publication
Avail: NTIS

Two RF admittance probes for use in the exosphere and also in the inner magnetosphere, where it is difficult to measure the thermal plasma density, are described. The results are compared with independent measurements of the electron density and with simple theoretical models. The effective sheath thickness around the probes and their suitability for space measurements are discussed. Author (ESRO)

N71-17047# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Jun. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, JUIN 1970]
1970 31 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated. ESRO

N71-17061# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Jul. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, JUILLET 1970]
1970 31 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated. ESRO

N71-17052*# GCA Technology Div., GCA Corp., Bedford, Mass.
INVESTIGATION OF THE D AND E REGIONS OF THE IONOSPHERE Final Report
L. G. Smith Jan. 1971 90 p refs
(Contract NASw-1402)
(NASA-CR-116441; GCA-TR-70-11-N) Avail: NTIS CSCL 04A

An experimental investigation of the ionosphere using sounding rockets is presented. The payload instrumentation and objectives are described for each of the twenty-one launches, covering the period 14 June 1966 to 11 Sepatember 1969. The experimental program includes four launches in Brazil during and following the total solar eclipse of 12 November 1966; three in Puerto Rico in September 1967 in cooperation with the Arecibo Ionospheric Observatory; and fourteen launches at Wallops Island including investigations of the ionosphere at sunrise and of anomalous winter absorption. Results of these experiments are being published in the scientific literature. Author

N71-17063*# California Univ., Berkeley. Space Sciences Lab.
ENZYME ACTIVITY IN TERRESTRIAL SOIL IN RELATION TO EXPLORATION OF THE MARTIAN SURFACE
W. H. Brams, R. G. Burns, M. H. El-Sayed, A. D. McLaren, and J. J. Skujins 1 Jan. 1971 105 p refs *Its* Space Sci. Lab. Ser. No. 12, Issue 2
(Grant NGL-05-003-079)
(NASA-CR-116439) Avail: NTIS CSCL 08M

Enzyme activities in soil, including abundance, persistence and localization of these activities, and procedures for detection and assay of enzymes in soils suitable for presumptive tests for life in planetary soils are discussed. A sensitive test for soil urease, based on hydrolysis of heat stable, C-urea(14) and the urease activity of ancient and buried soils are described. The behavior of enzymes in non-classical systems, on surfaces, in gels and coacervates, and at low humidity, as an aid to understanding enzyme action in the heterogeneous systems, soil is presented. Author

N71-17064# Kiruna Geophysical Observatory (Sweden).
ON THE DEPENDENCE OF SATELLITE RADIO SIGNALS SCINTILLATIONS ON ZENITH ANGLE
A. W. Wernik (Polish Acad. of Sci.) Sep. 1970 36 p refs
(KGO-704) Avail: NTIS

The zenith angle dependence of the scintillation index and of the ratio of the scintillation indices measured at two wavelengths were studied. The irregular layer was described by Gaussian, exponential, and si-type phase correlation functions and the resulting differences are discussed. The si-type correlation function gave the best irregularity sizes and explains scintillation intensity amplification observed in the case of small values of the rms phase deviation. Author (ESRO)

N71-17055# European Space Research Inst., Frascati (Italy).
ABSOLUTE INSTABILITY OF WHISTLER WAVES
Bruno Bertotti, Andre Rogister, and Karl Schindler Dec. 1970 8 p refs Submitted for publication
(ESRIN-IN-113) Avail: NTIS

Whistlers propagating obliquely to the magnetic field can be made absolutely unstable by a sufficiently large anisotropy in the electron velocity distribution for frequencies intermediate between the electron and ion cyclotron frequencies. Author (ESRO)

N71-17075# European Space Research Inst., Frascati (Italy).
A NONLINEAR THEORY OF TURBULENCE IN THE EQUATORIAL ELECTROJET, PART 1
Andre Rogister [1970] 18 p refs Submitted for publication
Avail: NTIS

The nonlinear development of the Farley-Buneman instability in the equatorial electrojet is considered. In the stabilization mechanism a turbulent (negative) vertical electron flux develops in the turbulent layer and in order to preserve charge neutrality, the (positive) vertical ion flux decreases accordingly. Hence the secondary electric field and the electrojet electron current also decrease, thereby quenching the instability. The predictions of the theory agree with the available experimental evidence. Author (ESRO)

N71-17076# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, May 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, MAI 1970]
1970 31 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated. ESRO

N71-17105# Lockheed Missiles and Space Co., Palo Alto, Calif.
IONOSONDE (IONOSPHERE PROBE) IN ORBIT
Ia. L. Alpert et al [1971] 3 p Transl. into ENGLISH from Pravda (Moscow), no. 8(19151), 8 Jan. 1971
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A news article on the Cosmos 381, launched on 2 December 1970, is presented. The orbit is almost circular, has an altitude of about 1000 km, and is inclined 74 deg from the equatorial plane. The basic experiment is vertical pulsed sounding in the 2 to 13.4 MHz range to determine electron concentration and distribution. Other experiments record intensity of solar wave emission, low frequency electromagnetic spectra, and satellite position in orbit and elevation relative to sun and geomagnetic field. N.E.N.

N71-17115# Hamburg Univ. (West Germany). Meteorol. Inst.
THE HYDRODYNAMIC ROUGHNESS OF THE SEA SURFACE [DIE HYDRODYNAMISCHE RAUHIGKEIT DER MEERESOBERFLAECHE]
Karl Brocks and Lutz Kruegermeyer 1970 64 p refs In GERMAN and ENGLISH *Its* Ber. des Inst. fuer Radio- und Maritime Meteorol. No. 14
Avail: NTIS

The effects of vertical air density stratification on the wind profile within the maritime boundary layer were investigated. More than 1000 simultaneous wind, temperature, and humidity profiles, measured in the Baltic Sea (1958) and the North Sea (1959), were used to derive the apparent roughness parameters as functions of wind speed. The data were consistent with vertical momentum flux measurements. ESRO

N71-17116# Department of Energy, Mines and Resources, Ottawa (Ontario). Div. of Geomagnetism.
SHORT NOTE ON UNITS IN MAGNETOSTATICS
F. Primdahl Charlottenlund Danish Meteorol. Inst. 1970 19 p refs Sponsored by Natl. Res. Council of Can. *Its* Geophys. Papers No. R-18
Avail: NTIS

The transition from emu to SI units involves conversion factors of 4 pi if the traditionally adopted units in the SI are used. It is shown that a convenient alternative is the conversion: 1 gamma = 1 nanotesla and 1 emu of magnetic moment/cu cm = 1000 ampere per meter for magnetic field strength and intensity of magnetization respectively. ESRO

N71-17137# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
DETERMINATION OF MEAN GRAVITY ANOMALIES BY A GENERALIZED FOURIER ANALYSIS OF SATELLITE ORBITS [BESTIMMUNG MITTLERER SCHWEREANOMALIEN MITTELS VERALLGEMEINERTER FOURIER-ANALYSE VON SATELLITENBAHNEN]
C. Reigber Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Oct. 1970 24 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-53) Avail: NTIS; ZLDI Munich: 4.65 DM

The method was applied to the deviations of a satellite orbit from an arbitrarily chosen reference one. Mean gravity anomalies were evaluated by inserting the amplitude spectrum of the Fourier analysis into a system of determining equations described in the report. Author (ESRO)

N71-17138# Technische Hogeschool, Delft (Netherlands). Lab. voor Geodesie.
GRAVITY ANOMALIES ON THE ATLANTIC OCEAN
G. L. Strang van Hees Sep. 1970 4 p refs
Avail: NTIS

Mean free air anomalies were estimated from continuous profile survey vessel measurements and Bouguer and isostatic anomalies (T = 20 and T = 30 km) were computed. The map of Navado 3 mean gravity anomalies is discussed. Author (ESRO)

N71-17139# Bochum Univ. (West Germany). Bereich Extraterrestrische Physik.
LARGE AREA PHOTOMETRY OF ARTIFICIAL NEUTRAL GAS CLOUDS [FLAECHENFOTOMETRIE KUENSTLICHER NEUTRALGASWOLKEN]
D. Hannemann Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1970 73 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-44) Avail: NTIS; ZLDI Munich: 14.95 DM

A dual channel photometer to record the brightness changes in artificial strontium and barium clouds at altitudes of 200 km and tests in Sweden are described. The data were accurate to 10%. Author (ESRO)

N71-17143# Danish Meteorological Inst., Charlottenlund.
PROGRESS IN ELF AND VLF EMISSION STUDIES AT HIGH LATITUDES
T. Stockfiet Jorgensen 1970 20 p refs Presented at the Aurora and Airglow Summer Advanced Study Inst., Kingston, Ontario, Can., 3 – 14 Aug. 1970 *Its* Geophys. Papers No. R-20
Avail: NTIS

Recent research on auroral hiss, VLF chorus and ELF hiss in the 100 – 100,000 Hz frequency range is reviewed. Occurrence, propagation, generation mechanisms, and relations to other phenomena are discussed. ESRO

N71-17149# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, May 1970 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, MAI 1970]
1970 42 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during May 1970 are presented. ESRO

N71-17150# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Jun. 1970 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, JUIN 1970]
1970 46 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during June 1970 are presented. ESRO

N71-17151# Bonn Univ. (West Germany). Physikalisches Inst.
MASS SPECTROMETER MEASUREMENTS OF THE NEUTRAL NUMBER DENSITIES IN THE LOWER THERMOSPHERE ABOVE FORT CHURCHILL [MASSENSPEKTROMETRISCHE MESSUNGEN DER NEUTRALGASDICHTE IN DER UNTEREN THERMOSPHAERE UEBER FORT CHURCHILL]
J. Gross and U. von Zahn Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Oct. 1970 72 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-55) Avail: NTIS; ZLDI Munich: 14,70 DM

A monopole mass spectrometer was launched on a Black Brant rocket and number density measurements of N2, O2, O and Ar were obtained in the altitude range from 111 to 156.5 km from which the total mass density was calculated. The turbopause altitude was 102 km. An unexpected high atomic oxygen content was found at altitudes above 135 km which may be connected with a PCA event on the same day. Author (ESRO)

N71-17152*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
WHISTLERS WITH HARMONIC BANDS CAUSED BY MULTIPLE STROKE LIGHTNING
Robert R. Shaw and Donald A. Gurnett Dec. 1970 19 p refs
(Contracts NAS5-10625; NAS1-8141; NAS1-8144; NAS1-8150; Grant NGR-16-001-043 et al Contract N00014-68-A-0196-003)
(NASA-CR-116456; Rept-70-61) Avail: NTIS CSCL 03B

Whistlers received with the Injun 5 satellite are frequently observed to have bands with decreased signal amplitude at equally spaced frequency intervals. The frequency spacing between the bands is typically about 10 to 30 Hz. As many as 30 such bands have been observed on a single whistler. Investigations are reported which show that the bands are due to double or multiple strokes in the initial lightning discharge, resulting in destructive interference of the whistler signal at equally spaced frequency intervals. The frequency spacing between the interference bands is given by the inverse of the time interval between the lightning strokes. This simple explanation accounts for a number of peculiar characteristics which could not be accounted for with the gyrofrequency harmonic interaction hypothesis. Author

N71-17170# Joint Publications Research Service, Washington, D.C.
POSSIBILITY OF DETERMINING CHARACTERISTICS OF THE SURFACE LAYER OF SOIL BASED ON ITS THERMAL RADIO EMISSION
K. Ya. Kondratyev et al *In its* Appl. Phys. 14 Jan. 1971 p 7–11 refs (See N71-17168 07-23)
Avail: NTIS

The use of microwaves for determining the surface layer, humidity, and temperature profile of soils is described. Mathematical expressions are developed for determining the brightness temperature, and approximate solutions are given. N.E.N.

N71-17261*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEMIANNUAL VARIATIONS IN THE NEUTRAL COMPOSITION
H. G. Mayr and H. Volland Nov. 1970 38 p refs
(NASA-TM-X-65443; X-621-70-478) Avail: NTIS CSCL 04A

Meteor trail observations of the meridional mesospheric wind field are analyzed in terms of spherical harmonics. A predominance in the P3 term suggests two heat sources, one that peaks at the equator associated with the semiannual migration of the sun between the two hemispheres and a second heat input of greater magnitude that peaks at high latitudes. The latter is presumably related to auroral heating associated with the semiannual component in the occurrence of magnetic storms. The wind circulation is shown to cause a semiannual redistribution of the minor constituent O in the lower thermosphere with the effects to decrease the ratios of O/N2 and O/O2 at high latitudes and to enhance these ratios at mid to low latitudes during equinox. This effect is consistent with the latitudinal structure in the semiannual component of the F2 region ionization and mass spectrometer measurements of the O/O2 ratio. As a consequence the pressure bulge in the O region of the thermosphere should be elongated around the equator and the semiannual variations in the exospheric temperature, deduced from satellite drag data at low inclination, should be too high. The model also reproduces the decrease in the relative concentration of O during summer consistent with the winter anomaly in the F2 region. Author

N71-17262*# TRW Systems Group, Redondo Beach, Calif.
COASTAL-ZONE OCEANOGRAPHIC REQUIREMENTS FOR EARTH OBSERVATORY SATELLITES A AND B, PART 1 Final Report
4 Feb. 1971 408 p refs
(Contract NAS1-10280)
(NASA-CR-111816) Avail: NTIS HC $6.00/MF $0.95 CSCL 08C

Information requirements for effective management and conservation of coastal zones, and the significant problem-oriented data provided by space platforms are discussed. Information needs were classified into the major priorities of pollution, fisheries, hazards to shipping and coastlines, geography, hydrology, and cartography. Experiment requirements and associated missions were independently developed for each of these, and for a multi-priority mission. Optimum and minimum sensor payload groupings and corresponding requirements were developed for each priority. The merit of performing the selected missions was also established. The results of the study show that there is a significant need for pollution and fisheries dedicated payloads. For coastal geography, hydrology, and cartography, there are requirements that EOS A/B could fulfill and which will not be provided by other spacecraft in the 1974–76 time frame. A mission dedicated to the hazards priority would not provide significant additional information beyond that currently planned by other spacecraft programs. Author

N71-17263*# TRW Systems Group, Redondo Beach, Calif.
COASTAL ZONE OCEANOGRAPHIC REQUIREMENTS FOR EARTH OBSERVATORY SATELLITES A AND B, PART 2 Final Report

4 Feb. 1971 248 p refs
(Contract NAS1-10280)
(NASA-CR-111817) Avail: NTIS CSCL 08C
For abstract see X71-17262.

N71-17264*# TRW Systems Group, Redondo Beach, Calif.
COASTAL-ZONE OCEANOGRAPHIC REQUIREMENTS FOR EARTH OBSERVATORY SATELLITES A AND B, SUMMARY Final Report
4 Feb. 1971 16 p
(Contract NAS1-10280)
(NASA-CR-111818) Avail: NTIS CSCL 08C
For abstract see X71-17262.

N71-17270*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRIC FIELD MEASUREMENTS AND THE IDENTIFICATION OF CURRENTS CAUSING MAGNETIC DISTURBANCES IN THE POLAR CAP
J. P. Heppner, J. D. Stolarik, and E. M. Wescott Oct. 1970 67 p refs
(NASA-TM-X-65447; X-645-71-50) Avail: NTIS CSCL 08N

Twelve Ba(+) clouds, released at invariant latitudes 76 to 78 deg, were under conditions typical for disturbances with Kp near 3. The electric field E was typically between 20 and 40 V/km, directed roughly from dawn toward dusk, more uniform in space and time than E fields observed in the auroral belt. The most important measurement was the finding of a large angular difference between the direction of E and Delta H, the horizontal polar cap magnetic disturbance. This meant that Delta H could not be caused by ionospheric Hall currents in the form of a sheet current across the polar cap; also the angular difference was of the opposite sign to that expected if other elements of the conductivity tensor were important. A new model for continuity of the Hall current auroral electrojets was developed. Continuity by way of field aligned currents is primarily a consequence of (grad N)/N being greater than (grad E)/E. The large scale properties of grad N/grad E appear to be compatible with the net distribution of field aligned currents required to explain both the Delta H and the simultaneous magnetic disturbance observed between roughly 50 deg magnetic latitude and the low latitude edge of the auroral belt. Author

N71-17272# Alaska Univ., College. Geophysical Inst.
EARTH TILTS IN CONNECTION WITH CRUSTAL FAILURE: A STUDY IN ALASKA
Ed Berg Oct. 1970 31 p refs
(Contract AT(45-1)-2095)
(RLO-2095-2) Avail: NTIS

Recordings with a sensitivity of a few millisec arc per millimeter on the tilt records of the Gilmore and Paxon stations are reported. Microearthquake data for the months of March 1970 in the Fairbanks area indicate a decrease in the b slope value prior to larger magnitude activity. The Vp/Vs ratios determined for shocks in the same time period are inconclusive as to their variation with seismic activity. However, changes reported from seismic field investigation in the literature are found consistent with the expected values due to increased porosity prior to failure. The porosity is due to the microfracturing and has been reported in the literature for various rock specimens in the laboratory. Experimental results of tilt amplitude from both the Alaskan network and those reported in the literature indicate that the tilt amplitudes associated with earthquakes diminish in the far field as the ratio 1/R. Observations of tilts preceding the Yakutaga quake on April 16 on the two stations GLM and PAX were obtained. Author

N71-17412*# Techtran Corp., Glen Burnie, Md.
CIRCULAR STRUCTURES ON EARTH AND ON THE PLANETS [KOLTSEVYYE STRUKTURY NA ZEMLE I PLANETAKH]
L. M. Shkerin Washington NASA Feb. 1971 16 p ref Transl. into ENGLISH from Priroda (Moscow), no. 10, 1970 p 55-61
(Contract NASw-2037)
(NASA-TT-F-13457) Avail: NTIS CSCL 08G

The features of the formation of circular structures of volcanic, meteoritic, and nuclear origin on earth are examined to determine the possible origin of similar structures on the moon and inner planets. Author

N71-17477# Lockheed Missiles and Space Co., Sunnyvale, Calif. Ocean Lab.
A STUDY OF THE SEDIMENTS WITHIN SUBMARINE GULLIES OFF DEL MAR, CALIFORNIA, WITH EMPHASIS ON THEIR MASS PHYSICAL PROPERTIES
F. Simpson and A. L. Inderbitzen Dec. 1970 100 p refs
(LMSC-698662) Avail: NTIS CSCL 08J

Cores were obtained along precisely controlled transects down the gully axes as well as on transects approximately perpendicular to the axes. Grain size distribution appears to be the only property directly related to topography. Within the submarine gullies, grain size decreases downslope in a seaward direction. Water content of the sediment increases as the grain size decreases. Examination of cores by comparison of the water content versus sediment depth profiles reflects the primary influence of grain size distribution. Multiple linear regression analyses indicate that the vane shear strength is primarily affected by depth in the sediment, by water content, and by percent clay. Water content values are also primarily affected by depth in the sediment and percent clay. Mineralogic composition of the material appears relatively homogeneous. Illite and mixed layer micas are the predominant clay minerals. An infinite slope analysis indicates that all but two of the areas sampled appear to be stable at their existing slope angles. Author

N71-17478*# Techtran Corp., Glen Burnie, Md.
COMPUTATION OF THE ELASTIC PARAMETERS OF ROCKS FROM THEIR MINERALOGICAL COMPOSITION [VYCHISLENIYE UPRUGIKH PARAMETROV GORIYKH POROD PO MINERALYNOMU SOSTAVU]
K. S. Aleksandrov et al Washington NASA Feb. 1971 27 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geol. (Moscow), no. 2, 1966 p 3-19
(Contract NASw-2037)
(NASA-TT-F-13446) Avail: NTIS CSCL 08G

The effect of the mineral qualities of a rock on its elastic properties is estimated by computing the elastic moduli of single- and multi-component rocks and comparing them so as to exclude the effect of other factors. Author

N71-17480# Joint Publications Research Service, Washington, D.C.
RELATIVISTIC THEORY OF ORIGIN OF THE EARTH'S MAGNETIC FIELD AND THE CONTRACTION MECHANISM
A. T. Aslanyan 25 Jan. 1971 4 p Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Geol. i Geogr. Nauki (Erevan), v. 13, no. 6, 1960 p 55-57
(JPRS-52234) Avail: NTIS

Spontaneous magnetization of the earth is discussed, based on Einstein's principle of relative simultaneity. Expressions are given for the magnetic field strength at the equator and at the poles. It is felt that the existence of permanent magnetic fields in rotating bodies is manifested as a logical result of the unity, opposition, and arbitrariness of separation of the gravitational and electromagnetic

forces. The contraction mechanism maintaining the existence of magnetic fields reflects axial rotation, and stops with cessation of axial rotation. N.E.N.

N71-17489# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 245 28 Jan. 1971 p 25–40 refs (See N71-17486 07-30)
Avail: NTIS

News items and research reports on the following topics are summarized: surface current mapping of the Indian Ocean, Oceanographic Commission operations, sea water photoluminescence, ocean bottom structure and global tectonics concepts, research vessel operations, light transmission in the sea, controlling ocean biological productivity, marine geology, current variability along 20 deg E longitude, water mass on Nova Scotia Shelf and over Georges Bank, hydrological regime in tropical Atlantic, water exchange between the Atlantic and Arctic, water mass boundary predictions, oxygen as an index of water mass structure, oxygen minimum formation in the ocean, biogenous components in shelf deposits, unsteady internal waves in a viscous fluid, ice drift currents, seismology of Romanche Trench, and long term changes in the ocean-atmosphere system. E.C.

N71-17490# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 245 28 Jan. 1971 p 41–65 refs (See N71-17486 07-30)
Avail: NTIS

News items and research reports are summarized on geodesy, magnetism, and seismology instrumentation and research. E.C.

N71-17491# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 245 28 Jan. 1971 p 66–97 refs (See N71-17486 07-30)
Avail: NTIS

News items and research reports are summarized on the Soviet space program with emphasis on Lunokhod 1 operations; and atmospheric and ionospheric, and interplanetary phenomena investigations. E.C.

N71-17492# Joint Publications Research Service, Washington, D.C.
SUPPLEMENT: WORK OF THE UNDERWATER RESEARCH LABORATORY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 245 28 Jan. 1971 p 98–105 (See N71-17486 07-30)
Avail: NTIS

Diving instrument development is reviewed along with the Sadko sealab series underwater research program. E.C.

N71-17537# Congress. Senate. Committee on Public Works.
WATER POLLUTION: 1970, PART 1
Washington GPO 1970 405 p refs Hearings before the Comm. on Public Works, 91st Congr., 2d Sess., 20, 21, and 27 Apr. 1970
Avail: Subcomm. on Air and Water Pollution

Congressional hearings on proposed legislation amending the Federal Water Pollution Control Act and other legislation relating to water pollution control are reported. Testimony is given by various government officials and private citizens on the need for water pollution control legislation. See also N71-17538 through N71-17541. R.B.

N71-17538# Congress. Senate. Committee on Public Works.
WATER POLLUTION: 1970, PART 2
Washington GPO 1970 504 p refs Hearings before the Comm. on Public Works, 91st Congr., 2d Sess., 28–30 Apr., 1 and 6 May, 1970
Avail: Subcomm. on Air and Water Pollution

For abstract, see N71-17537. See also N71-17539 through N71-17541. R.B.

N71-17539# Congress. Senate. Committee on Public Works.
WATER POLLUTION: 1970, PART 3
Washington GPO 1970 81 p refs Hearings before the Comm. on Public Works, 91st Congr., 2d Sess., 26–28 May, 1970
Avail: Subcomm. on Air and Water Pollution

For abstract, see N71-17537. See also N71-17538, N71-17540, and N71-17541. R.B.

N71-17540# Congress. Senate. Committee on Public Works.
WATER POLLUTION: 1970, PART 4
Washington GPO 1970 233 p refs Hearings before the Comm. on Public Works, 91st Congr., 2d Sess., 8 Jun. 1970
Avail: Subcomm. on Air and Water Pollution

For abstract, see N71-17537. See also N71-17538, N71-17539, and N71-17541. R.B.

N71-17541# Congress. Senate. Committee on Public Works.
WATER POLLUTION: 1970, PART 5
Washington GPO 1970 474 p refs Hearings before the Comm. on Public Works, 91st Congr., 2d Sess., 9–10 Jun. 1970
Avail: Subcomm. on Air and Water Pollution

For abstract, see N71-17537. See also N71-17538, N71-17539, and N71-17540. R.B.

N71-17700# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE ERRORS OF DETERMINING THE EARTH'S POTENTIAL FROM MEASUREMENTS OF GRAVITY ON A GIVEN SURFACE [OB OSHIBKAKH OPREDELENIYA POTENTSIALA ZEMLI PO IZMERENIYAM SILY TYAZHESTI NA IZVESTNOI POVERKHNOSTI]
V. G. Shkodrov Sep. 1970 13 p refs Transl. into ENGLISH from Byul. Stantsii Opticheskogo Nablyudeniya Iskusst. Sputnikov Zemli, Akad. Nauk SSSR (USSR), no. 55, 1969 p 68–73 (AD-715151; ACIC-TC-1649) Avail: NTIS CSCL 8/5

Coefficients C sub nm and S sub nm (n,m less than or equal to 4) of the spherical harmonic expansion of the potential have been derived in terms of the surface characteristics and the gravity distribution. The earth being modeled by two attracting mass points, the values of C sub nm, S sub nm (n,m less than or equal to 4) have been calculated both with the formulae of this method and with the exact ones. The conclusion has been drawn that it is advisable to determine the sectorial harmonics and the tesseral ones with large second indexes from gravity measurements, while the zonal harmonics and the tesseral ones with small second indexes are better determined not from gravity, but from satellite motions. Author (GRA)

N71-17722*# California Univ., Los Angeles. Dept. of Geology.
EXTRACTABLE ORGANIC MATTER IN PRECAMBRIAN CHERTS
J. W. Smith, J. William Schopf, and I. R. Kaplan *In its* Micropaleontological Studies of Lunar Samples Jan. 1971 18 p refs Repr. from Geochim. Cosmochim. Acta (London), v. 34, 1970 p 659–675 (See N71-17717 07-30)
(Contract NAS9-8843)
(Publ-803) Avail: NTIS CSCL 08G

The concentrations of hydrocarbons and fatty acids, and the

ratios of the stable isotopes of carbon and sulfur were determined for Precambrian cherts from the Gunflint Iron-Formation, the Paradise Creek Formation, and the Bitter Springs Formation. All three cherts are known to contain organically preserved microfossils. For comparison, studies were conducted on two fossiliferous Phanerozoic cherts of comparable origin and geologic history. The highest concentrations of n-alkanes, pristane and phytane, and saturated and unsaturated fatty acids were generally recovered from the untreated surfaces of the samples; these compounds are primarily of recent origin. Extremely small concentrations of similar compounds were extracted from interior portions of the Precambrian samples. These compounds are not demonstrably syngenetic with original sedimentation, and the major portion of these extracts also appears to be of relatively recent origin. Permeability and porosity measurements conducted on separate rock samples from the collection on which the organic studies were made, showed the presence of microfractures that could allow the passage of ground water under a pressure gradient. Author

N71-17731# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Scence.

PROBABILISTIC ERROR ANALYSIS OF AIRBORNE GRAVIMETRY

Peter Meissl Jun. 1970 114 p refs

(Contract F19628-69-C-0127)

(AD-715268; AFCRL-70-0396; Rept-138; SR-8) Avail: NTIS CSCL 8/5

An error analysis based on second order stochastic process theory is performed for airborne gravimetry. Only gravimetry in the traditional sense is considered as opposed to gravity-gradient methods. Stochastic error models are developed and computer programs for the final formulas have been written. Sample computations indicate that gravity averages over about 100 km may be seriously deviation from the optimal filter due to lack of knowledge about the medium frequent portion of the power spectra of gravity variation and noise. Author (GRA)

N71-17736# Kansas Univ., Lawrence. Center for Research.

STRUCTURAL ANALYSIS FROM RADAR IMAGERY, EASTERN PANAMANIAN ISTHMUS

Richard S. Wing Aug. 1970 159 p refs

(Contract DAAK02-68-C-0089)

(AD-715322; CRES-TR-133-15) Avail: NTIS CSCL 8/7

The Panamanian isthmus where three major crustal plates have apparently long interacted, records a strain pattern that can be used to help advance knowledge of global tectonics. Recent radar coverage has provided this previously unobtainable surface geologic data. A belt of (individually) north-trending left-lateral en echelon anticlines nearly bisects Darien Province, extends northwestward across the Pacific Hills, and culminates in compound large-scale faulted folds adjacent to the east end of the Maje Range. Observed distortion within this belt is compatible with postulated left-lateral movement at depth between longitudinal blocks which constitute the isthmus and paralled its trend. A similar strain pattern is in evidence in the Majr Range. The Panamanian Isthmus is situated in the southwest corner of the Caribbean plate which it is postulated, has been subject to compression from active translation of the South American plate. Eastern Panama has apparently been subject to left-lateral simple shear deformation because of the oblique orientation of the principal compressive stress relative to the nonhomogeneous make-up of the isthmus. In addition, the Caribbean plate has been moving slightly eastward, relative to South America, and the drag between them may account for observed right-lateral transisthmian distortion, notably from San Miguel Bay northward to the Caribbean. Author (GRA)

N71-17745# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Applied Mathematics.

THEORETICAL SEISMOLOGY Final Report, 1 Jul. 1966–30 Jun. 1970

C. L. Pekeris Jul. 1970 15 p refs

(Contract N00014-67-0146)

(AD-715126) Avail: NTIS CSCL 8/11

The principal themes investigated in the report were: Development of techniques for computation of theoretical seismograms; The determination of hidden periodicities in seismic records; Recomputation of seismic travel times; The inversion of seismic data; The smoothing of seismological travel-time tables; Development of numerical methods for the processing of seismic data; The Zoeppritz amplitude equations and reflection and refraction coefficients; and Theoretical amplitude coefficients for seismic phases. Author (GRA)

N71-17748# California Univ., San Diego, Calif. Scripps Institution of Oceanography.

GEOLOGICAL AND GEOPHYSICAL OBSERVATIONS IN AN ABYSSAL HILL AREA USING A DEEPLY TOWED INSTRUMENT PACKAGE

B. P. Luyendyk 1 Jun. 1970 112 p refs

(Contract N00014-69-A-0200-6002)

(AD-714852; SIO-REF-70-14; MPL-U-35/70) Avail: NTIS CSCL 8/10

In order to study the smaller scale geological and geophysical phenomena of the deep ocean floor near-bottom observations have been made over two north-south trending abyssal hills in the northeast Pacific. The study area is located in a region of magnetic lineations 130 kilometers south of the Murray Fracture Zone (vicinity 32 deg 25N, 125 deg 45W). The hill on the west is an elongate shield volcano, while the eastern hill is a block fault (horst) structure. The hills have a variable sediment cover that is thickest in the valley between them. The horizontal variation in sediment thickness is affected primarily by continuous down-slope transport of sediments resuspended by burrowers; and further, by covering of the sedimentary section by lava flows, trapping of sediments in local depressions and base levels, non-deposition or erosion due to spatially varying bottom currents, and mass movement. Measurements of the relative sedimentation rate show that it is presently up to twice as high in the valley as on the adjacent highs. The magnetic anomalies measured at depth are lineated parallel to the bottom topography and the anomalies at the ocean surface. Magnetic model studies suggest that they are caused by a magnetization within the second layer that varies smoothly in a direction perpendicular to the lineations. Empirical evidence from other authors suggests that paleofield fluctuations, frozen into the crust as it is created at the crests of oceanic rises, are the most likely cause. Author (GRA)

N71-17762 Colorado State Univ., Fort Collins.

OPERATIONAL GENERAL RELATIVITY

James William Kummer (Ph.D. Thesis) 1969 66 p

Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-22317

In order to distinguish between physical and coordinate effects in an arbitrary gravitational field, the space coordinate system and the clock rates must be specified operationally a priori. Once this is done, it is no longer possible to set up an initial surface arbitrarily, since this operation must be consistent with certain physical experiments, whose results depend upon the particular physical situation. A method is given for setting up the initial surface, thereby completing the prescription for seperating coordinate effects from physical effects. The time evolution of the system is discussed, with a critical analysis of causality for clocks. Alternatively, a slight revision in the formulation of the theory is suggested which eliminates the problems associated with the setting up of an initial surface. Furthermore, the revised equations contain fewer terms than those of the conventional theory, thereby somewhat simplifying the solution of a problem. Dissert. Abstr.

N71-17801# Delaware Univ., Newark.
RESEARCH IN THE COASTAL AND OCEANOGRAPHIC ENVIRONMENT Annual Status Report, 1 Sep. 1969–31 Aug. 1970
William S. Gaither Oct. 1970 37 p refs
(Contract N00014-69-A-0470; Proj. Themis)
(AD-714853; CMS-3MD028) Avail: NTIS CSCL 8/3

Progress during the first year of a multidisciplinary study of the coastal environment of a section of the Atlantic Sea Coast (Delaware and adjacent New Jersey and Maryland areas) is summarized. Included are field, laboratory, and theoretical investigations of sedimentary processes, coastal vegetation, tidal marsh soils, wave action and attenuation, air-sea interactions, geological history and marine biology. Correlation of ground observations with high altitude photographic imagery to provide a useful method for the remote characterization of such coastal regions is an important objective. Author (GRA)

N71-17813# Denver Univ., Colo. Dept. of Physics.
FLOW OF RADIATION IN THE EARTH'S ATMOSPHERE Final Report, 1 Dec. 1965–31 May 1969
Walter J. Williams, Frank H. Murcray, David G. Murcray, and Thomas G. Kyle Jan. 1970 259 p refs
(Contract AF 19(628)-5706)
(AD-715269; AFCRL-70-0415) Avail: NTIS CSCL 4/1

Four grating spectral radiometers and a filter radiometer were designed, constructed and flown on a balloon vehicle five times to measure atmospheric radiance from 5 to 20 microns. Measurements were made at twelve different angles between zenith and nadir and at altitudes up to 100,000 feet. The equipment and calibration procedures are described. Numerous sample spectra are presented showing the change in radiance with both angle and altitude. A program is developed for theoretically calculating atmospheric radiance. This program combines a line by line calculation of atmospheric transmittance with a sixteen layer model of the atmosphere to calculate emission at various angles and altitudes. Author (GRA)

N71-17814# Air Force Cambridge Research Labs., Bedford, Mass.
OPTICAL PROPERTIES OF THE ATMOSPHERE
R. A. McClatchey, R. W. Fenn, J. E. A. Selby, J. S. Garing, and F. E. Volz 22 Sep. 1970 98 p refs *Its* Environ. Res. Papers No. 331
(AD-715270; AFCRL-70-0527) Avail: NTIS CSCL 4/1

A series of tables and charts are presented from which the atmospheric transmittance between any two points in the terrestrial atmosphere can be determined. This material is based on a set of five atmospheric models ranging from tropical to arctic and two aerosol models. A selected set of laser frequencies has been defined for which monochromatic transmittance values have been given. For low resolution transmittance prediction, a series of charts have been drawn providing the capability for predicting transmittance at a resolution of 20 wave-numbers. Separate sections are included on scattered solar radiation, infrared emission, refractive effects, and attenuation by cloud and fog. Author (GRA)

N71-17815# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
SEISMIC WAVE PROPAGATION STUDIES Final Report, 1 Jun. 1966–30 May 1970
D. E. Willis, P. L. Jackson, and R. M. Turpening Sep. 1970 37 p refs
(Contract AF 49(638)-1759; ARPA Order 292-32)
(AD-715316; Rept-8071-33-F; AFOSR-70-2390TR) Avail: NTIS CSCL 17/10

A new method of simulating seismic rays, computing travel times, and approximating amplitudes in earth models has been developed. The digital computer is used to model a spherical or a flat earth. Two- or three- dimensional models are employed. The method can be used for heterogeneous models, and includes computation of multiple reflections. Travel times have been obtained for a model of a cross-section underlying LASA. A data processing capability specifically intended for the study of the S-wave particle variations across LASA was built on this contract. Microseismic investigations in connection with JORUM indicated that the firing of a large yield underground shot did not produce any measurable tectonic release of energy in active fault regions at a distance of 60 to 100 km from the source. Travel time studies of PcP and P were used to determine the surface configuration of a portion of the earths core. Spectral studies were made of underground nuclear shots and earthquakes recorded at teleseismic, regional and near distances. An additional study was made of the characteristics of seismic background noise recorded on the bottom of Lake Superior. Author (GRA)

N71-17833# DBA Systems, Inc., Melbourne, Fla.
NEAR TERM PROSPECTS FOR POSITIONAL ACCURACIES OF 0.1 TO 1.0 METERS FROM SATELLITE GEODESY Final Report, May 1969–Aug. 1970
Duane C. Brown 20 Aug. 1970 99 p refs
(Contract F19628-69-C-0264)
(AD-715292; AFCRL-70-050123) Avail: NTIS CSCL 8/5

An investigation is made into four specific approaches to geodetic positioning that hold promise for improvements in accuracies by an order of magnitude over accuracies to be expected from the geodetic satellite programs of the 1960s. Author (GRA)

N71-17834# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
GEOMORPHOLOGIC INTERPRETATION FOR LANDSCAPE STUDIES
I. A. Volkov 1970 4 p Transl. into ENGLISH from the book "Primenenie Aerometodov Primenenie v Landshaftnykh i Issledovaniyakh" Moscow-Leningrad, Akad. Nauk SSSR. Labratorii Aerometodov, 1961 p 253–254
(AD-715050; FSTC-HT-23-553-68) Avail: NTIS CSCL 8/6

At the present time, Soviet physical goegraphy shows a condition from general, comparatively cursory descriptions of extensive areas to a more fundamental thorough study of small sections of territory of Russia with a detailed analysis of the correlations in their development and mapping. The geologic structure and relief determine greatly the area distribution of large geographic units (for example, provinces, geographic zones). Of still greater importance is the study of the specific features of the geologic structure and relief and detailed geographic studies which are accompanied by more detailed demarcation, that is, in landscape studies proper. These components of the landscape exert a deep influence on local relationships of heat and moisture and predetermine to a considerable degree the area disposition of the boundaries, the morphologic composition and structure of the landscape itself as well as its components. Author (GRA)

N71-17835# Pittsburgh Univ., Pa. Space Research Coordination Center.
FULL WAVE SOLUTION FOR THE TRANSMISSION OF ULF AND ELF WAVES THROUGH THE IONOSPHERE Final Report, 1 Nov. 1966–30 Sep. 1970
Yuji Inoue and D. Lynne Shaeffer 30 Sep. 1970 245 p refs
(Contract F19628-67-C-0109)
(AD-715301; AFCRL-70-0531) Avail: NTIS CSCL 4/1

Full wave solutions have been found for plane wave and localized disturbances in the ULF (micropulsation) and ELF frequency ranges. Slow and fast wave disturbances incident at 5000 km. altitude at the frequencies 100, 3.0, 1/3, and 1/300 cps. were analyzed. A model ionosphere developed from existing rocket and

satellite data for conditions of midday and midlatitude at sunspot minimum was used in the calculations. The cold plasma dispersion relation was written conveniently in terms of the localized disturbance factor and the ionospheric conductivity tensor elements. The localized disturbances were found to produce large vertical electric fields in the neutral atmosphere for the incident slow waves in the micropulsation range and the incident fast wave at 100 cps. Author (GRA)

N71-17856# Aerospace Corp., San Bernardino, Calif.
FLATJACK TESTS Technical Report, Apr. – Dec. 1969
Warren Pfefferle and Craig R. Smith 6 Dec. 1970 51 p
(Contract F04701-70-C-0059)
(AD-715264; TR-0059(S6970)-1; SAMSO-TR-70-381) Avail: NTIS CSCL 8/7

Tests were conducted utilizing large flat jack devices placed in a vertical slot for high pressure loading of rock to measure in-situ properties of a rock mass. The high pressure flat jack devices were used as a site investigation tool to obtain rock mass properties. Tests were conducted before and after a 100 ton surface high explosive detonation test to assess explosive effects on the rock. It was conslusively demonstrated by these tests that meaningful flat jack tests could be successfully accomplished; also, a significantly different response of the rock medium was measured as larger areas of rock were loaded. Surface jointing was severely disturbed by the explosion. Author (GRA)

N71-17859# Army Electronics Command, Fort Monmouth, N.J.
FIELD TEST OF A NEAR REAL-TIME IONOSPHERIC FORECASTING SCHEME (60 KM)
George E. Krause, Richard J. D'Accardi, and Edwin L. Roswell, III Oct. 1970 83 p refs
(AD-714995; ECOM-3345) Avail: NTIS CSCL 4/1

Two ionospheric sounder terminals were assembled and ionogram data were taken in vertical and oblique incidence over a 60 km path from Fort Monmouth, New Jersey to Fort Dix, New Jersey. A statistical analysis method was developed and used to demonstrate that there was no appreciable difference between vertical incidence MOFs taken at one terminal, and oblique MOFs over this 60 km path. A near real-time prediction scheme was successfully adapted to use vertical incidence data to predict MOFs for the 60 km oblique path. Data from the field test was used to compare observed and predicted MOFs for 10, 30, and 60 minutes in the future. Author (GRA)

N71-17863# Naval Research Lab., Washington, D.C. Applied Physics Branch.
THE POSSIBILITY OF ELECTROMAGNETIC WAVE DUCTING IN THE IONOSPHERE
S. J. Stephanakis, W. W. Balwanz, W. S. Ament, and W. R. Faust 6 Nov. 1970 25 p refs
(AD-715338; NRL-7171) Avail: NTIS CSCL 20/14

The refractive index of the ionosphere varies with altitude, providing optimum wave curvature for around-the-world propagation. The variation also provides ducts which tend to focus waves into this optimum curvature. Simple calculations using published ionospheric properties are used to demonstrate the wave curvature and the duct structure. The duct altitude varies between 90 and 300 km depending on the frequencies used and the diurnal variations of the ionosphere. Signal loss varies widely, providing around-the-world propagation with less than a 5-dB loss per earth traverse in some of the duct configurations. Methods of coupling into the ducts are assumed based on reports by other investigators. Signal scatter, which provides one method for coupling into and out of the duct, adds to the calculated signal loss from electron collisons. Author (GRA)

N71-17873# California Univ., La Jolla. Inst. of Geophysics and Planetary Physics.
LOW FREQUENCY DISCRIMINANTS FOR SMALL EVENTS Final Report
Freeman Gilbert and Donald Helmberger 13 Oct. 1970 63 p refs
(Contract F44620-69-C-0118)
(AD-715328; AFOSR-70-2637TR) Avail: NTIS CSCL 8/11

The Cagniard-deHoop method in generalized ray theory is extended to spherically layered media. The theory is approximate and is asymptotic in reciprocal fractional powers of the frequency. For mantle body wave phases it is estimated that the theory can be used for P pulses with periods less than 40 superscript s and S pulses with periods less than 75 superscript s. An initial application of the theory to the study of LRSM recordings of NTS events shows: (1) models derived from travel time data alone may have synthetic seismograms that disagree with observations; (2) the structure of the upper mantle beneath North America has very significant lateral variations in the uppermost 700 km. Some classical results in normal mode theory have recently been uncovered. They permit one to study the residual static displacement field, caused by an earthquake or explosion, in terms of the normal mode eigenfunctions. The dynamical and statistical fields have the same expansion coefficients in the normal mode representation. Consequently, there is an indirect method for finding static fields. Author (GRA)

N71-17874# Army Electronics Command, Fort Monmouth, N.J.
STUDIES OF WAVELIKE VARIATIONS IN THE IONOSPHERE
P. R. Arendt, F. J. Gorman, Jr., and H. Soicher Sep. 1970 24 p refs
(AD-714993; ECOM-3332) Avail: NTIS CSCL 4/1

Determination of the true height of specific ionospheric plasma frequencies has been used for finding actual motions within the ionospheric plasma. The reported vertical soundings reveal a periodic variation in time at all bottomside altitudes. Spatial variations of this periodic structure have been observed at points separated by about 50 km. Daytime and nighttime periodic structures are different. Periodic variations of angle-of-arrival data of an oblique propagation experiment on a 1330-km circuit have been observed. The periodicities are related to spatial periodic electron density structure in the bottomside ionosphere. The oblique reflections had dominant azimuth periods in the order of 1/4, 1/2, and 1 hour. Author (GRA)

N71-17950# Grumman Aerospace Corp., Bethpage, N.Y. Geo-Astrophysics Section.
A THEORETICAL ASSESSMENT OF THE STANDARD PENETRATION TEST
Edward A. Nowatzki Feb. 1971 19 p refs Proposed for presentation at the 4th Panam. Conf. on Soil Mech. and Found. Eng., San Juan, Puerto Rico, 14 – 18 Jun. 1971
(RM-494-J) Avail: NTIS

Static and dynamic penetration tests are widely used in the field and laboratory to obtain comparative measures of soil strength. Although the inherent inadequacies of the Standard Penetration Test (SPT) have been recognized from past experience, no theoretically rigorous method of analysis of the test exists. A theoretically correct three dimensional static analysis of the SPT, using plasticity theory and the Coulomb failure criterion, is presented. The differential equations of plastic equilibrium are solved numerically for an ideal homogeneous dry sand to show the variation of slip line field geometry and ultimate load with changes in a number of pertinent variables. The results are assessed with reference to their bearing on the factors that have been observed to influence blow count data in the field. Author

N71-17957# Pacific Oceanographic Labs., Seattle, Wash.
BATHYMETRY AND MAGNETICS OF A REGION (POL-421-3) 29 DEG TO 35 DEG N, 155 DEG TO 165 DEG W
David K. Rea Dec. 1969 71 p refs
(ESSA-TR-ERC-146-POL-4) Avail: SOD $1.00

Bathymetric and magnetic anomaly maps of an area in the central north Pacific Ocean have been prepared from data collected for ESSA's SEAMAP project to delineate and interpret the topographic and magnetic features present. The bathymetric map includes the northern portion of the Musicians Seamounts, a part of the Murray fracture zone, a large elevated fault block, a small part of the Hawaiian Arch, and abyssal hills. The magnetic anomaly map shows normally polarized local dipole anomalies associated with the seamounts and linear dipole anomalies associated with fault scarps. Two linear dipole anomalies not associated with topography may reflect shear zone that resulted from a change in direction of sea-floor spreading and that was offset by a minor transform fault. Author

N71-17959# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
THERMAL EXCHANGE BETWEEN WATER CURRENTS AND ATMOSPHERE IN WINTER TIME
V. M. Samochkin 1970 7 p refs Transl. into ENGLISH from Transport (USSR), v. 7, 1966 p 101–104
(AD-715048; FSTC-HT-23-689-68) Avail: NTIS CSCL 4/1

The investigations as well as the comparison of the calculation and observation data on the position of the ice edge at the lower water level of the Novosibirsk Hydroelectric Power Plant justify the recommendation of the formulas developed by S. N. Kritsky, M. F. Menkel, K. I. Rossinskiy and P. P. Kuzmin to determine the heat losses from the surface of a water current due to evaporation and convection in wintertime. Author (GRA)

N71-17966*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BOSTON COLLEGE ENVIRONMENTAL CENTER SUMMER INSTITUTE ON SURTSEY AND ICELAND
Cyril Ponnamperuma and James W. Skehan (Boston Coll.), eds. Feb. 1971 142 p refs Conf. held in Chestnut Hill, Mass., 15 Jun.–1 Jul. 1970; sponsored by NASA, NSF, Surtsey Res. Soc., and Boston Coll. Environ. Center
(NASA-TM-X-62009) Avail: NTIS CSCL 08G

Using a combined lecture-field program, the geology, geochemistry, and biology of Iceland and Surtsey were studied as examples of new and extreme environments. Geological studies included the examination of various forms of volcanism, glaciation, thermal sites, nunatak formation, and palagonite fields. Biological field studies emphasized the primary and secondary colonization of newly formed land, comparative ecology, and the study of extreme environments, and included application of life detection techniques to planetary exploration. For individual titles, see N71-17967 through N71-18000.

N71-17967*# Museum of Natural History, Reykjavik (Iceland). Dept. of Geology and Geography.
ICELAND: A PECULIAR ENVIRONMENT OF MAN
Sigurdur Thorarinsson *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 15–17 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

The geological, topographical, and climatological features of Iceland are described. The effects of the climate, lack of wood, and poor soil on human habitation of the island are discussed. R.B.

N71-17968*# Museum of Natural History, Reykjavik (Iceland). Dept. of Geology and Geography.
THE HEKLA FIRES: A PRELIMINARY REPORT OF THE 1970 MOUNT HEKLA VOLCANIC ERUPTION. A REPORT FROM THE SMITHSONIAN INSTITUTION CENTER FOR SHORT-LIVED PHENOMENA, 15 JUNE 1970
Sigurdur Thorarinsson *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 18–19 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

An eruption which occurred in the Mt. Hekla region of Iceland on May 20, 1970 is described. The eruption was characterized by heavy tephra production, rich in fluorine, which caused lethal fluorine poisoning in grazing livestock. Later fissures produced negligible amounts of tephra, but lava production was heavy. R.B.

N71-17969*# Agricultural Research Inst., Reykjavik (Iceland).
COLONIZATION OF LIFE ON REMOTE ISLANDS
Sturla Fridriksson *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 20–22 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

Ecological investigations were conducted in Iceland, the Westman Islands, and the newborn volcanic island of Surtsey to determine the mechanisms by which plant and animal life are transported to remote islands. The limitation imposed by edaphic and climatic factors on the growth condition of newly arrived plant parts is also considered. R.B.

N71-17970*# Industrial and Development Inst., Reykjavik (Iceland).
A FEW NOTES ON THE GEOLOGY OF ICELAND
Gudmundur Sigvaldason *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 23–25 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

The history of the geological development of Iceland is reviewed. The effects of volcanoes and volcanic features on the geological history of the island are discussed. R.B.

N71-17971*# Industrial and Development Inst., Reykjavik (Iceland).
HIGHLIGHTS OF THE SURTSEY ERUPTION: 1963–1967
Gudmundur Sigvaldason *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 26–27 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

A chronological summary is given of the volcanic eruption and formation of Surtsey Island between 1963 and 1967. R.B.

N71-17972*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHEMICAL EVOLUTION: ITS RELEVANCE TO SURTSEY
Cyril Ponnamperuma *In its* Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 28–31 refs (See N71-17966 07-13)
Avail: NTIS CSCL 08G

Chemical evolution is defined as the study of the processes which culminated in the formation of life. The theory is applied to the life processes on Surtsey Island near Iceland. It is proposed that life-detection techniques developed for planetary exploration be tested on Surtsey, because the conditions of the island resemble those of the primordial earth and those which may be encountered on other planets. R.B.

N71-17973*# National Aeronautics and Space Administration. Washington, D.C.

THE PLANETS AND LIFE

Richard J. Young *In its* Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 32–34 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08G

The planets in the solar system are discussed with respect to the possibility of life's evolving on them. Surtsey and Iceland are suggested as natural laboratories to test life-detection techniques, because of their harsh environments, which may resemble those on other planets. R.B.

N71-17974*# Boston Coll., Chestnut Hill, Mass. Environmental Center.

INTRODUCTION TO GEOLOGICAL STUDIES

James W. Skehan *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 35 (See N71-17966 07-13)

Avail: NTIS CSCL 08G

The existing geological knowledge of Surtsey and Iceland, gathered from interdisciplinary interchanges in the field, in lectures, and in discussions, is summarized. Important scientific discoveries of the past and areas of research applicable to Icelandic geology are highlighted. R.B.

N71-17975*# Pennsylvania State Univ., University Park. Dept. of Geochemistry and Minerology.

SEA-FLOOR SPREADING AND THE COMPOSITION OF ICELANDIC LAVAS

Arthur L. Boettcher *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 36–41 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08C

Recommendations are made for investigating the composition and ages of the Icelandic lavas to determine the validity of sea floor spreading. Previous studies of Quaternary rocks from the neovolcanic zone show a high FeO and Fe2O3 and SiO2 content in the youngest lavas, and more primitive compositions in the prehistoric rocks. Petrographic studies, augmented by microprobe analyses of selected minerals, are recommended to detect any secondary alteration of the rocks. It is also suggested that comparative studies be made of Quaternary and Tertiary lavas. R.B.

N71-17976*# Texas Univ., El Paso. Dept. of Geological Sciences.

HEKLA AND THE 1970 ERUPTION

Jerry M. Hoffer *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 42–44 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08G

A chronological record is given of the eruption of Hekla volcano on May 5, 1970. The amount of tephra production and composition of the lava flows are recorded through June, 1970. A historical summary of previous Hekla eruptions is also presented. R.B.

N71-17977*# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla.

ICELAND AS AN ATYPICAL EXAMPLE OF THE PETROLOGY OF THE MID-ATLANTIC RIDGE

Jose J. Honnorez *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 45–49 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08G

The geological relationships between various rock strata of Iceland and the Mid-Atlantic Ridge (MAR) are compared. The basic discrepancies between the petrology and tectonics of the MAR and Iceland are discussed. The discrepancy between the Icelandic and submerged MAR relative to the acidic rocks is explained by the different thicknesses of the basaltic layer in the two areas. R.B.

N71-17978*# Lamont Geological Observatory, Palisades, N.Y.

THE MID-ATLANTIC RIDGE IN ICELAND

Jurgen Kienle *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 50–53 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08J

The hypothesis of sea-floor spreading and continental drift is investigated with respect to the location of Iceland at lithospheric plate boundaries. Microearthquake studies are suggested to delineate the Mid-Atlantic Ridge crest through Iceland, and fault plane solutions are suggested to study the nature of the ridge offsets in southern and northern Iceland. Other suggested methods of study include gravitational and magnetic surveys and the tectonic relationships of the southern fracture zone. R.B.

N71-17979*# Grand Valley State Coll., Allendale, Mich. Dept. of Geology.

PHYSICAL FEATURES ON ICELANDIC LAVA FLOWS

Richard H. Lefebryre *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 54–57 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08G

Lava flows that range widely in age, composition, and physical characteristics were observed. The physical characteristics are the most obvious features of these flows and are used to compare the Icelandic basalts with the Columbia River flood basalt province in the northwestern United States. Only the subaerial flows of the Tertiary in eastern Iceland and the recent and Pleistocene flows in the neovolcanic zone of central Iceland are included. Author

N71-17980*# Eastern Washington State Coll., Cheney, Wash. Dept. of Geology.

PLUTONIC ROCKS OF ICELAND

Felix E. Mutschler *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 58–59 (See N71-17966 07-13)

Avail: NTIS CSCL 08G

Although the bulk of the Tertiary to Holocene igneous rocks of Iceland are basaltic volcanics, coarse-grained plutonic rocks which range in composition from gabbro to granite are also exposed locally. Three types of occurrence have been recognized: (1) inclusions ranging from gabbro to granite, found in flow basalts, (2) coarse-grained igneous rocks in the eroded cores of central volcanoes, and (3) granitic rocks occurring as dikes and veins which cut fine-grained basaltic volcanics in the mixed lavas of the Lon district. Topics are also suggested for petrologic research, geologic research related to the biological sciences, and economic geology research. Author

N71-17981*# Arizona State Univ., Tempe. Dept. of Geology.

TEXTURAL ANALYSIS OF SURTSEY TEPHRA: A PRELIMINARY REPORT

Michael F. Sheridan *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 60–64 refs (See N71-17966 07-13)

Avail: NTIS CSCL 08G

Textural analysis of modern pyroclastic and hydroclastic deposits on Surtsey is used to characterize ancient tephra units. The grain-size distribution is also useful for interpreting transportation and deposition mechanisms related to the various modes of eruption and emplacement. Author

N71-17982*# Geological Survey, Bloomington, Ind.
FLUORINE-BEARING ASH FROM THE HEKLA ERUPTION, 1970: DISTRIBUTION, EFFECT ON ENVIRONMENT, AND IMPLICATIONS FOR MEDITERRANEAN ARCHEOLOGY AND GEOMYTHOLOGY
Dorothy B. Vitaliano *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 65–68 refs (See N71-17966 07-13)
Avail: NTIS CSCL 08G

The eruption of the Hekla volcano on May 5, 1970 is discussed with respect to its effects on the environment and economy of Iceland. Large numbers of livestock were poisoned from eating grass on which fluorine-bearing ash particles from the eruption had fallen. It is suggested that the sudden disappearance of the Minoan civilization on Crete and the Biblical plagues of Egypt may have been caused by similar effects of fluorine-bearing ash from the eruption of the Santorin volcano about 1450 BC. R.B.

N71-17983*# Boston Coll., Chestnut Hill, Mass. Environmental Center.
CONCLUSION OF GEOLOGICAL STUDIES
James W. Skehan *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 69 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

The results of disciplinary and interdisciplinary research into the geology of Iceland are summarized. Areas for further research are suggested. R.B.

N71-17984*# Rice Univ., Houston, Tex. Dept. of Chemistry.
ORGANIC GEOCHEMISTRY OF ICELAND'S EXTREME ENVIRONMENTS
Pat Haug *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 71–74 refs (See N71-17966 07-13)
Avail: NTIS CSCL 08D

The glaciers, hot springs, and volcanic ash from erupting volcanoes in Iceland were studied for hydrocarbon content, which represents the end product of diagenesis. By determining the influx of organic matter into such extreme environments, knowledge is gained about the origins of life and about techniques for detecting life on other planets. R.B.

N71-17985*# Stanford Univ., Calif. Dept. of Civil Engineering.
BIOGEOCHEMISTRY OF PHOSPHORUS: ITS ROLE IN ECOSYSTEM DEVELOPMENT. A PRELIMINARY STATEMENT ON SOME POSSIBLE RESEARCH TOPICS RELEVANT TO SURTSEY AND ICELAND
James O. Leckie *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 75–79 refs (See N71-17966 07-13)
Avail: NTIS CSCL 08D

The processes of chemical and biochemical weathering of primary volcanic rock, the subsequent soil formation, and the role that both processes play in the transport and accumulation of nutrients as a whole were investigated for the ecosystem of Surtsey Island. The role of phosphorus in the primary productivity of natural systems is emphasized. R.B.

N71-17986*# Arizona State Univ., Tempe. Center for Meteorite Studies.
ENVIRONMENTAL RELATIONSHIPS TO THE CHEMISTRY OF THERMAL WATERS
Carleton B. Moore *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 80–83 refs (See N71-17966 07-13)
Avail: NTIS CSCL 08D

Samples were collected on Surtsey and Iceland to determine selected trace elements in rocks from various volcanic and hot spring areas. Preliminary analysis indicates that the carbon and nitrogen content of the rocks are similar to other basalts, although a sample of altered basalt taken from the rim of a thermal spring shows significantly higher carbon and nitrogen contents. R.B.

N71-17987*# Maryland Univ., College Park. Dept. of Chemistry.
A PRELIMINARY REPORT ON SOME MINERALOGICAL ASPECTS OF ICELAND AND SURTSEY
Sheldon Sommer *In* NASA. Ames Res. Center Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 84–85 (See N71-17966 07-13)
Avail: NTIS CSCL 08G

The environment of zeolite formation in the Tertiary basalts of southeastern Iceland and the stability of recently formed minerals in the beach sands of Surtsey are discussed. The minerals are to be analyzed by electron microprobe, X-ray millipробe, and luminescence spectroscopy to determine the population of impurity ions acting as activators on individual cation sites. R.B.

N71-18000*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SELECTED BIBLIOGRAPHY ON SURTSEY
Ilga Pubulis, comp. *In its* Boston Coll. Environ. Center Summer Inst. on Surtsey and Iceland Feb. 1971 p 125–138 refs (See N71-17966 07-13)
Avail: NTIS CSCL 08G

A bibliography is presented of papers and information on Surtsey Island. The bibliography is divided into three categories of general, biology, and physical science, with authors listed alphabetically under each heading. R.B.

N71-18031# Institute for Telecommunication Sciences, Boulder, Colo.
AN ATLAS OF OBLIQUE-INCIDENCE HIGH-FREQUENCY BACKSCATTER IONOGRAMS OF THE MIDLATITUDE IONOSPHERE
Robert D. Hunsucker Mar. 1970 157 p refs
(ESSA-TR-ERL-162-ITS-104) Avail: SOD $1.25 CSCL 04A

An atlas of data photographs of oblique-incidence high-frequency backscatter ionograms of the midlatitude ionosphere from the period 1952–1969 is presented. Representative examples of data acquired by the range-azimuth scan, range-elevation scan, range-time, sweep-frequency and PPI backscatter techniques are displayed. No attempt is made to interpret the backscatter signatures, but publications which present analyses and interpretations of backscatter data are referenced. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N71-18027# Illinois Univ., Urbana. Water Resources Center.
MICROSCOPIC OPEN CHANNEL BOUNDARY LAYER VELOCITY MEASUREMENT USING A VIRTUAL IMAGE METHOD Termination Report
Harry G. Wenzel and Kuo C. Cheng Apr. 1970 39 p refs
(Contract DI-14-01-0001-1632)

(PB-195163; WRC-RR-31) Avail: NTIS CSCL 20D

A method for velocity measurement is described which employs a microscope and high speed motion picture camera to record the motion of small tracer particles suspended in the flow. The procedure, termed the image method, involves particle illumination such that the particle itself and its virtual image created by reflection from a boundary both appear on the film. The boundary is then located equidistant from the two images. The plane of focus is oriented normal to the boundary giving a picture of the entire velocity profile normal to the boundary within the limits of the field of view. A frame by frame analysis of the particle motion can yield velocity profile and turbulence information. Author (GRA)

N71-16981# Lockheed Missiles and Space Co., Palo Alto, Calif.
TELESCOPES BEYOND THE LIMITS OF EARTH
A. A. Mikhailov [1970] 3 p Transl. into ENGLISH from Pravda (Moscow), no. 326 (19104), 22 Nov. 1970 p 3
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Extraterrestrial observatories carrying telescopes can provide new information on celestial bodies and cosmic space by: (1) perceiving radiation from the shortest X-ray and gamma radiation to long radiowaves; (2) exposing details of stellar system and galactic structures; and (3) receiving unhindered cosmic rays and corpuscular fluxes. Astronomical progress is insured by combined and coordinated earthbound and extraterrestrial observations. G.G.

N71-16982# Lockheed Missiles and Space Co., Palo Alto, Calif.
X-RAY TELESCOPE ON THE MOON
V. Kurt [1970] 3 p Transl. into ENGLISH from Izv. (Moscow), no. 275(16585), 20 Nov. 1970
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

An X-ray telescope was mounted onto the Lunokhod-1 for investigation of quasars and galaxies after deposition on the lunar surface. The absence of a magnetic field on the moon diminishes the charged particle background and permits prolonged accumulation of a weak signal from an X-ray source. G.G.

N71-16993# Lockheed Missiles and Space Co., Palo Alto, Calif.
NEW ON-BOARD INSTRUMENTS
F. Gerchikov [1970] 4 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 9, 1970 p 20–21
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The design of a sensitive altimeter for high speed aircraft and space vehicles is described. The instrument uses radioactive radiation from the aircraft, together with energy level measurements of photons reflected from earth, for control. Reflected photons proceed to a detector, through an amplifier and to an altitude pulse selection circuit whereupon the signal Poisson distribution is converted into a Gaussian distribution and then into normal signals. Altimeter accuracy at the 2.5 to 3m critical preset-down flight altitude is about 2.5 cm, which is satisfactory for jet aviation demands. G.G.

N71-17048# National Accelerator Lab., Batavia, Ill.
ELECTRONIC DETECTORS: 1969 SUMMER STUDY, VOLUME 3
Arthur Roberts, ed. 1969 343 p refs Sponsored by AEC
(TID-25473-Vol-3) Avail: NTIS; HC $6.00/MF $0.95

Papers are presented on detectors, detection techniques, and spectrometer systems for measuring charged and neutral particle velocity, trajectories, and position. N.E.N.

N71-17101# Danish Meteorological Inst., Charlottenlund.
NOTE ON A SECOND-HARMONIC PHASE-SENSITIVE-DETECTOR WITH FUNDAMENTAL REFERENCE VOLTAGE
F. Primdahl 1970 11 p refs *Its* Geophys. Papers No. R-19
Avail: NTIS

A simple phase-detector for fluxgate magnetometers was constructed using two matched zeners, two resistors, and a capacitor. It can detect signals below the 1 gamma level. Author (ESRO)

N71-17134# Royal Aircraft Establishment, Farnborough (England).
NOTES ON THE STABILITY AND DYNAMIC RESPONSE OF AN ELECTROSTATIC FEEDBACK PRESSURE TRANSDUCER
H. K. P. Neubert Jul. 1970 29 p ref
(RAE-TR-70120) Copyright. Avail: NTIS

The nonlinear static response and the linearized dynamic performance of the high sensitivity transducer are derived and static and dynamic instabilities are discussed. Author (ESRO)

N71-17173*# Massachusetts Inst. of Tech., Cambridge. Spectroscopy Lab.
TECHNIQUES FOR RULING IMPROVED LARGE DIFFRACTION GRATINGS Final Report, 1 Mar. 1966–31 Jan. 1971
George R. Harrison 31 Jan. 1971 17 p refs
(Grant NGR-22-009-167; MIT-DSR-Proj. 76264)
(NASA-CR-116457) Avail: NTIS CSCL 14B

Extensions of techniques are reported which were developed for controlling interferometrically the ruling engines for large diffraction gratings. Progress resulting from the A and B engines is briefly summarized and the development of a C engine is described. With the completion of this engine, satisfactory gratings up to 12 in. × 15 in. have been ruled and are in use in several observatories. The results are presented of technology employed to improve the quality of the C engine rulings at higher angles than 25 deg and having the ability to rule 16 in. × 24 in. master echelles. D.L.G.

N71-17174# Hawaii Univ., Honolulu.
PROPORTIONAL QUANTAMETER FOR THE 15 FOOT BUBBLE CHAMBER
D. Yount 23 Jul. 1970 19 p refs
(UH-511-83-70) Avail: NTIS

The performance of a proportional quantameter to detect and measure the energy of the neutral pions produced by neutrino interactions in the 15-foot bubble chamber is evaluated. The total energy is determined from the sum of a number of wire outputs, while spatial resolution is obtained by reading out other wire planes individually. Author (NSA)

N71-17183# Union Carbide Corp., Oakridge, Tenn. Y-12 Plant.
AUTOMATED QUANTOMETER DATA HANDLING SYSTEM
G. L. Bowers and R. C. Maxson 25 Nov. 1970 136 p
(Contract W-7405-eng-26)
(Y-1740) Avail: NTIS

Analysis by spectrographic methods requires that large volumes of data be recorded and processed; and, prior to element analysis, a time-consuming system calibration procedure must be completed. To automate the data acquisition, data analysis, and calibration procedures, a small digital computer has been interfaced to a direct-reading spectrograph (quantometer). Development of this system has essentially eliminated several hours of menial paper work which were required to prepare the quantometer for each day's work, thereby making the instrument useful for producing analysis. Two methods of analysis were utilized: aluminum spark and uranium carrier distillation. Author (NSA)

N71-17267# Atomics International, Canoga Park, Calif.
LMFBR TASK 25, TRANSIT TIME FLOWMETER Quarterly Technical Progress Report, Jul. – Sep. 1970
P. J. Pekrul 12 Nov. 1970 11 p
(Contract AT(04-3)-701)
(AI-AEC-12981) Avail: NTIS

The development of a flowmeter using noise-analysis techniques which will be suitable for use as a flow-measurement standard in large liquid-metal systems at temperatures to 1200 F or higher is described. Operation of the Transit Time Flowmeter depends upon the detection of small temperature variations (thermal eddies) at two points a known distance apart in a flowstream. The two signals are cross-correlated with a variable delay time. The delay time which gives maximum correlation is the transit time of the fluid between the sensors, which time is inversely proportional to the fluid velocity. NSA

N71-17273# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE INFLUENCE OF THE SHAPE OF THE CROSS-SECTION ON THE BEHAVIOUR OF BOURDON SPRINGS
W. Wuest 1970 14 p refs Transl. into ENGLISH from Ing.-Arch. (Berlin), v. 20, 1952 p 116 – 125
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Round tabular springs of oval cross-section, called Bourdon springs, are used in engineering as pressure sensors and are produced in large quantities. Whereas an oval form similar to an ellipse was originally preferred, the last decades have shown an increasing preference for the flat arc-form, primarily for reasons of ease of manufacture. For a given form of the cross-section (for example, ellipse, flat-arc, pointed), the behaviour of thin tubular springs is primarily determined by the axis ratio alpha and the parameter Lambda equals a squared divided by sr (a-larger semi-diameter, s-wall thickness, r-radius of curvature). Bases for calculation are presented for cross-sections which are made up of circular arcs or straight lines (bowed cross-sections) with the special cases of pointed cross-sections and flat-arc cross-sections. Author

N71-17274*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PERFORMANCE OF AN ALUMINUM OXIDE HYGROMETER ON THE NASA CV 990 AIRCRAFT METEOROLOGICAL OBSERVATORY
E. Hilsenrath and R. L. Coley Jan. 1971 17 p refs
(NASA-TM-X-65446; X-651-71-37) Avail: NTIS CSCL 14B

An aluminum oxide hygrometer has been flown on several meteorological expeditions, including BOMEX and the June 1970 flights over the Arctic Ocean, the continental United States, and the Gulf of Mexico. Water vapor data are available for most of these flights. A standard aluminum oxide probe was mounted in a specially designed air sampler. A control unit was designed such that the hygrometer system would be compatible with the flight environmental computer flown on board the 1970 expedition. Comparisons were made with other aircraft measurements yielding water vapor data and with humidity data from radiosondes, when available. These comparisons substantiate the validity of the suggested corrections to radiosonde data obtained during BOMEX. These flights have also demonstrated the negligible temperature dependence of the hygrometer data and the rapid time response of the configuration flown in a jet aircraft, which yield useful water vapor data in the range from +15C to −60C. Author

N71-17275*# Wisconsin Univ., Madison.
PIONEER PLASMA PROBE INSTRUMENT SIMULATION STUDY
Grace Wahba Nov. 1970 65 p
(Contract NAS2-5233)
(NASA-CR-114273) Avail: NTIS CSCL 14B

The development of techniques for estimating as many as possible of the (steady state) plasma parameters from data observed by Pioneer 9 space probe instruments is discussed. The basic technique involves a mathematical model of the instrument response and a mathematical model of the solar wind particle velocity vector distribution as a function of its parameters. A nonlinear least squares algorithm in conjunction with these models has been successfully used to estimate the parameters. Author

N71-17309*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE USE OF THE SCANNING ELECTRON MICROSCOPE AS A SEMICONDUCTOR PRODUCTION LINE QUALITY CONTROL TOOL
John W. Adolphsen and Robert J. Anstead *In* NBS Silicon Device Process. Nov. 1970 p 384 – 397 refs (See N71-17276 07-26)
(NASA-TM-X-66620) Avail: NTIS; SOD $5.50 CSCL 14B

The use of the scanning electron microscope (SEM) as an in-line, quality control tool to determine the integrity of metallization on semiconductor devices is recommended. The detection of a bad metallization lot reduces lost time to four to six weeks instead of thirty weeks. While these are benefits which accrue to the user, the paramount requirement of the proposed scheme is that pertubation to the vendor's normal processing be minimal. A nonstatistical sampling plan specifies the quantity and location sites of dice to be viewed by the SEM. These factors are determined by the order size, device (die) size, geometrical configuration of the slice holder in the metallizing chamber, number or type of metallizing source elements, and static or dynamic position of the slice holder relative to the source(s). The premise of the scheme is that opens or potential latent opens in the metallization at the oxide steps are batch process problems. Author

N71-17319*# Bendix Corp., Teterboro, N.J. Navigation and Control Div.
HYDROSTATIC FLUID BEARING GYRO, VOLUME 1 Final Report
R. J. Sgambati Sep. 1970 115 p
(Contract NAS8-24414)
(NASA-CR-102991) Avail: NTIS CSCL 17G

The design and testing of three prototype gyro assemblies are reported. The units were built by reworking standard AB5-K8 gas bearing parts (sleeves, and plates, and cylinders) for the hydrostatic liquid bearing. The liquid in the unit is recirculated by means of a spiral groove pump located within the sealed, self-contained system. The pump was designed for minimum size and power consumption, consistent with the pressure and flow requirements of the bearing. The study has shown that precision inertial components, utilizing liquid hydrostatic inner gimbal support, can be built. A unit of this type combines the desirable characteristics of both gas bearing and floated components, and a significant feature is the optimum thermal design. Author

N71-17377# Sussex Univ., Brighton (England). School of Applied Sciences.
HEAT TRANSFER INSTRUMENTATION
A. B. Turner *In* AGARD High Temp. Turbines Jan. 1971 18 p refs (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

A brief review of heat transfer instrumentation with particular attention to the requirements of the gas turbine engineer is presented. The work is focused primarily on heat fluxmeters, recent developments in methods of temperature measurement and thermocouple installation errors. In this latter section a numerical procedure for the problem of sensors embedded in csulation channels is presented together with some correlations and predictions for typical examples in solid and porous surfaces. Author

N71-17379# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
TEMPERATURE MEASUREMENTS WITH THERMOCOUPLES INCLUDING ERRORS CAUSED BY CATALYTIC EFFECTS
P. Stottmann *In* AGARD High Temp. Turbines Jan. 1971 10 p refs (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

Several methods for the temperature measurement in combustion gas are discussed, especially the measurement with thermocouples. Corrections for compensation of the influences due to flow velocity, radiation, and heat conduction are described. In case of using noble metal thermocouples the possible errors by catalytic effects are studied. Experimental results are presented, which show the ignition of a fuel-air-mixture outside the boundary layer of the probe, initiated by the catalytic influence of the platinum surface. The reproducible catalytic effects, which initiate or force reactions in a gaseous fuel-air-mixture are dependent on the external flow conditions, gas temperature, gas velocity, fuel-air-ratio, and the distribution and evaporation of the fuel. Coating the noble metal surfaces with Al2O3 avoids the catalytic effects. Author

N71-17474# Joint Publications Research Service, Washington, D.C.
THEORY OF PARAMETRIC INTERACTION OF SOUND WAVES IN PIEZOSEMICONDUCTORS [K TEORII PARAMETRICHESKOGO VZAIMODEYSTVIYA ZVUKOVYKH VOLN V P'YEZOPOLUPROVODNIKAKH]
Yu. V. Gulyayev et al 26 Jan. 1971 13 p refs Transl. into ENGLISH from the Russian
(JPRS-52245) Avail: NTIS

Sound waves in piezosemiconductors interact with one another due to nonlinearities of the medium, which have mainly an electronic origin. A special case of such interaction arises when one of the sound waves is more intensive than the rest. Then the reverse influence of weak waves on the intensive can be neglected and the latter can be considered given. The given wave (pumping) creates heterogeneities of the parameters of the medium periodic in space and time. The weak waves are scattered on those heterogeneities and can be transformed into one another. It is natural to speak of such processes as the parametric interaction of weak waves through pumping. Author

N71-17508# Idaho Nuclear Corp., Idaho Falls.
ULTRASONIC VOID FRACTION DETECTOR USING COMPRESSIONAL STRESS WAVES IN A WIRE HELIX
A. W. Arave Oct. 1970 18 p ref
(Contract AT(10-1)-1230)
(IN-1441) Avail: NTIS

An ultrasonic void fraction detector to measure steam voids in water is being developed for the Loss of Fluid Test (LOFT). The detector is a 3/16 inch wire wound into a 6 turn, 1/4 inch diameter, 4 inch long helix. The attenuation of a 200 Hz compressional stress wave as it propagates in the helix is a function of the void fraction at the helix surface. A magnetostrictive transducer is used on one end of the helix as a transmitter and another on the other end as a receiver. Author (NSA)

N71-17574* Westinghouse Electric Corp., Pittsburgh, Pa.
HIGH RESOLUTION DEVELOPING OF PHOTOSENSITIVE RESISTS Patent
Charles J. Taylor, inventor (to NASA) Issued 29 Jul. 1969 (Filed 7 Sep. 1966) 3 p Cl. 96-49; Int. Cl. G03c1/58, 5/34 Sponsored by NASA
(NASA-Case-XGS-04993; US-Patent-3,458,313; US-Patent-Appl-SN-577775) Avail: US Patent Office CSCL 14E

A composition and process for improving the definition of resin masks used in chemical etching are discussed. The composition, used for developing organic-solvent-soluble photosensitive etch resists, is comprised of about 50–75 percent organic solvent with about 25–50 percent dipropyl carbonate. The process of developing an exposed organic-solvent-soluble photosensitive etch resist includes the step of contacting the image area with the above described developer which results in a developed image that has both improved resolution and a reduced undercut. Official Gazette of the U.S. Patent Office

N71-17575* Beckman Instruments, Inc., Fullerton, Calif.
PULSE ACTIVATED POLAROGRAPHIC HYDROGEN DETECTOR Patent
John N. Harman, III, inventor (to NASA) Issued 28 Apr. 1970 (Filed 29 May 1968) 7 p Cl. 204-195; Int. Cl. G01n27/54, 27/46 Sponsored by NASA
(NASA-Case-XMF-06531; US-Patent-3,509,034; US-Patent-Appl-SN-732917) Avail: US Patent Office CSCL 20F

A polarographic hydrogen detector having three electrodes, a platinized anode, a copper reference electrode and an auxiliary electrode, and a system for periodic reactivation of the platinized anode by means of potential pulsing are described. The electrodes are disposed in a housing containing a liquid electrolyte and having a permeable membrane for introduction of hydrogen. Hydrogen is oxidized at the anode, and a current proportional to hydrogen partial pressure is produced. A short-duration cycle of positive and negative potential pulsing is applied periodically to the anode in order to maintain the activity of the platinized anode. A memory and disabling circuit connected to the current output of the detector eliminates the current surges produced during pulsing. Official Gazette of the U.S. Patent Office

N71-17576# California Univ., Berkeley. Lawrence Radiation Lab.
ATOM PROBE FIELD ION MICROSCOPE
Kaj Gunnar Stolt [1970] 50 p refs
(Contract W-7405-eng-48)
(UCRL-20303) Avail: NTIS

The instrument consists of a normal field ion microscope connected to a time of flight spectrometer. The microscope is a bakeable all metal system with a capability of reaching a pressure of n torr. A dynamical supply of the imaging gas is utilized. Cold helium gas pumped from a liquid helium dewar is used for cooling the tip. The specimen holder provides electrical shielding of the tip region where the acceleration of the field evaporated ions takes place, and also cools this region. The specimen can be centered to within + or − 0.2 mm of the axis of the drift tube and is rotatable through its tip by + or − 45 deg vertically and + or − 90 deg horizontally. The cooling of the tip is not effective enough and at present the tip temperature can be brought down to only 40 K. Another shortcoming of the specimen holder is its inability to withstand higher voltages than 15–20 kV. With the present instruments the mass resolution is limited to about m/Delta m = 100. A method of calibrating the atom probe is described and it is shown that improving the instrumentation could improve the resolution by about a factor of 2. Author

N71-17577# California Univ., Livermore. Lawrence Radiation Lab.
EQUIPMENT AND TECHNIQUE FOR FORMING SENSITIZED PHOTOGRAPHIC FILM TO A SPHERICAL SHAPE
Edward L. Pierce 3 Sep. 1970 22 p Sponsored by AEC
(UCRL-50926) Avail: NTIS

A process for forming sensitized polyester-base photographic film to a spherical shape using heat and a pressure differential was developed. The curvature remained stable over a period of three

years, and film and emulsion quality remained high. This forming was accomplished with a minimum of fogging and breakdown of emulsion in the form of pinholes or cracks. Author

N71-17580# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.
NON-CONTACT GAGING
L. W. Black Oct. 1970 3 p
(Contract DA-11-173-AMC-487(A))
(MHSMP-15) Avail: NTIS

A method to make linear measurement where it is desirable or mandatory to avoid contact with the material was developed. Although the noncontact gage was designed and built for use on two specific applications (thickness of foam silicone cushions and height of a neoprene tube protrusion above a solid surface), this concept can be tooled to accommodate a wide variation of applications. The precision of measurement is approximately + or 0.00015 inch (three standard deviations) when measuring a stable surface such as a gage block. The gage is equipped with a micrometer graduated in 0.00002-inch increments. This concept is adaptable to any situation where a shadow may be projected onto the surface to be measured. The design features a gage resting on a surface plate. Any thickness material may be measured, limited only by the range of the micrometer head. Author

N71-17584* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARALLEL PLATE VISCOMETER Patent
Harold H. Broyles and Howard F. Broyles, inventors (to NASA) Issued 17 Mar. 1970 (Filed 7 Aug. 1967) 9 p Cl. 73-57; Int. Cl. G01n11/10 Sponsored by NASA
(NASA-Case-XNP-09462; US-Patent-3,500,677;
US-Patent-Appl-SN-658957) Avail: US Patent Office CSCL 14B

An instrument is described which is capable of measuring the true shear viscosity of liquids and viscoelastic materials. The instrument operates on the parallel plate method of viscosity measurement, using optical flats instead of the usual parallel plates. The sample material whose viscosity is to be measured is placed between a pair of horizontal optical flats, the upper optical flat is adjusted until it is touching the sample, and is then released. The rate of fall of the upper plate as it reduces the height of the sample material to a particular value is recorded by a suitable recorder coupled to a linear displacement transducer. The absolute viscosity of the sample is then determined by computing a simple formula. Official Gazette of the U.S. Patent Office

N71-17585* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANGULAR POSITION AND VELOCITY SENSING APPARATUS Patent
Leo J. Veillette, inventor (to NASA) Issued 17 Mar. 1970 (Filed 28 Jul. 1967) 13 p Cl. 318-138; Int. Cl. H02p7/28
(NASA-Case-XGS-05680; US-Patent-3,501,664;
US-Patent-Appl-SN-656953) Avail: US Patent Office CSCL 14B

A system is described for regulating brushless DC motors of the type where an internal stator field is rotated in space 90 deg ahead of the rotor field. To maintain the correct spatial relation between the stator and rotor fields, the angular position of the rotor is continually sensed and the position indication is used to continually change the stator field orientation as the rotor rotates. The rate of rotation of the rotor is also determined to provide controlled-damping and rate-limiting of the motor. Official Gazette of the U.S. Patent Office

N71-17586* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CONTOUR SURVEYING SYSTEM Patent
Colossie N. Batts, Frederick W. Gibson, and Robert W. Hess, inventors (to NASA) Issued 20 Oct. 1970 (Filed 23 Oct. 1967) 7 p Cl. 73-105; Int. Cl. G01b5/20; Int. Cl. G01n29/00
(NASA-Case-XLA-08646; US-Patent-3,534,596;
US-Patent-Appl-SN-677476) Avail: US Patent Office CSCL 14B

An X–Y carriage moves a traveling transducer over the surface to be surveyed, while a shaker moves the surface. A reference transducer located near the shaker generates a reference signal which is compared with a signal from the traveling transducer. This comparison provides a response phase relationship signal over the vibrating surface and is used to control a reversing device. The signal from the traveling transducer also separately passes through the reversing device, which maintains unilateral output polarity. The signal from the traveling transducer after passing through the reversing device is recorded on a digital card punch system and/or on an X–Y plotter. Suitable devices are included for sensing the position of the carriage in both the X and Y directions. The position sensors are utilized with the digital card punch and X–Y plotter systems so that the records obtained can be interpreted. Official Gazette of the U.S. Patent Office

N71-17587* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GRAVIMETER Patent
Orlo K. Hudson, inventor (to NASA) Issued 17 Mar. 1970 (Filed 19 Feb. 1968) 8 p Cl. 73-382; Int. Cl. G01v7/00
(NASA-Case-XMF-05844; US-Patent-3,500,688;
US-Patent-Appl-SN-706564) Avail: US Patent Office CSCL 14B

A gravimeter having a vacuum chamber is described in which a body having a light-reflective surface is allowed to fall. An interferometer system is associated with the body, including a stationary reflective surface for producing interference fringes as the body falls and a polarization rotator for balancing the amplitude of the reflected light from the body and the stationary reflective surface. A data collection system for counting with respect to time, in two adjacent time spans, the interference fringes, is provided, yielding a value of acceleration of the falling body. Official Gazette of the U.S. Patent Office

N71-17588* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HIGH PRESSURE GAS FILTER SYSTEM Patent
John A. Hauser, inventor (to NASA) Issued 20 Jan. 1970 (Filed 30 Nov. 1967) 7 p Cl. 55-179; Int. Cl. B01d50/00, 53/04
(NASA-Case-MFS-12806; US-Patent-3,490,205;
US-Patent-Appl-SN-686933) Avail: US Patent Office CSCL 13K

A system is described for purifying and filtering gases such as air and helium that have been compressed to a high pressure by oil lubricated compressors. The purification and filtering is accomplished by passing the gas through three sequential stages as follows: (1) scrubbing towers containing gas impingement filling or packing, such as Raschig rings, that remove droplets and mists of oil and water; (2) adsorption beds that remove further remains of mists of oil and moisture and also removes oil and moisture down to molecular size; and (3) felt filter elements which by depth filter action extract oil vapors and filter any dust particles which may be generated by any agitation of the adsorption beds of stage two. The system has very high flow, holding, and pressure capacities. Official Gazette of the U.S. Patent Office

N71-17605*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FREQUENCY RESPONSE OF TWO TYPES OF LIQUID-METAL PRESSURE TRANSDUCERS WITH STANDOFF TUBES
Joseph S. Curreri Washington Feb. 1971 17 p refs

(NASA-TN-D-6166; E-5992) Avail: NTIS CSCL 14B

Frequency response tests were conducted on two types of pressure transducer systems commonly used in liquid-metal space power systems. Each transducer was an absolute pressure sensor with a range of 0 to 50.0 psia. The tests were conducted using constant-diameter tubing (i.d., 0.187 in.) ranging in length from 6 to 24 in. The process fluids were mercury and aliphatic petroleum naphtha solvent. Sinusoidal pressure fluctuations were applied at peak-to-peak pressure amplitudes of 5.0 psia generated at an average pressure level of 25.0 psia over a frequency range of 0.4 to 40 Hz. The data are presented in terms of amplitude ratio and phase angle as a function of logarithmic frequency. The results are cross-plotted to show natural frequency as a function of tube length. The data are also compared with theoretical predictions. Author

N71-17606# California Univ., Berkeley. Lawrence Radiation Lab.
CALIBRATION OF AN INFRARED PYROMETER
G. A. McCoy, R. A. Olstad, and D. R. Olander Sep. 1970 56 p refs
(Contract W-7405-eng-48)
(UCRL-19665) Avail: NTIS

The behavior of an InSb infrared pyrometer and a calibration curve in the temperature range 200 C to 2200 C are discussed. The detector responds to radiation in the 2 – 6 micron range. At temperatures below 1000 C the calibration was carried out using a commercial black body source. For calibration above 1000 C, two graphite black body configurations were used, and calibration consisted of matching the infrared pyrometer signal with the corresponding temperature measured by an optical pyrometer. All calibrations are for a black body hole 0.156 inches diameter with room temperature surroundings, at a pyrometer-to-source distance of 24 inches. A correction factor was derived for black body holes of various sizes with surroundings hot enough to contribute to the detector signal. A response time of less than 10 microseconds was measured. The repeatability varied from plus and minus 2 C at low temperatures to plus and minus 8 C at 2000 C. The uncertainty is largely due to the operator's skill in aligning the instrument. An error at higher temperatures is due to the uncertainty in the optical pyrometer measurements. Author

N71-17621*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF DEVELOPMENT
In its Space Programs Sum. No. 37-66, Vol. 2. The Deep Space Network 30 Nov. 1970 p 114–140 ref (See N71-17612 07-07)
Copyright. Avail: NTIS CSCL 14B

DSIF operations are reported for the following: DSS upgrades for Mariner Mars 1971, exciter development for the Block 4 receiver, development of techniques for Mark 3 implementation, programmed oscillator development, high-speed data/wideband data input/output assembly, post-detection recorder evaluation, and rebuilding of tau ranging subsystem. R.B.

N71-17626* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VISCOUS PENDULUM DAMPER Patent
Wilmer H. Reed, III, inventor (to NASA) Issued 27 Jan. 1970 (Filed 28 Mar. 1968) 9 p Cl. 188-1; Int. Cl. F16d63/00
Continuation-in-part of US Patent Appl. SN-581128, filed 8 Aug. 1966, which is a Division of US Patent Appl. SN-435756, filed 26 Feb. 1965
(NASA-Case-LAR-10274-1; US-Patent-3,491,857;
US-Patent-Appl-SN-717052) Avail: US Patent Office CSCL 14B

A vibration damper is described in which a mercury filled pendulous bladder mass is located in a viscous fluid. The pressure in the bladder is remotely variable to alter the size and the damping characteristics. In another variant, the tubular container damper has a group of scalloped tray sections filled with a viscous liquid, each section having a slug mass to dissipate energy.
Official Gazette of the U.S. Patent Office

N71-17627* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR CONTROLLING THE VELOCITY OF AN ELECTROMECHANICAL DRIVE FOR INTERFEROMETERS AND THE LIKE Patent
Grady B. Nichols, inventor (to NASA) Issued 6 Jan. 1970 (Filed 28 Mar. 1968) 6 p Cl. 356-106; Int. Cl. G01b9/02
(NASA-Case-XGS-03532; US-Patent-3,488,123;
US-Patent-Appl-SN-538913) Avail: US Patent Office CSCL 14B

An apparatus is described for providing velocity control of the electromechanical drive mechanism of the scanning mirror of an interferometer, in which a signal proportional to the linear velocity of the mirror is derived from the interferometer and is fed to a comparator, which also receives a reference signal of the same character. The output of the comparator is supplied to the energizing coil of the electromechanical drive mechanism to provide corrective action, resulting in a constant linear velocity for the movement of the scanning mirror.
Official Gazette of the U.S. Patent Office

N71-17655* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTERFEROMETER DIRECTION SENSOR Patent
Rudolf A. Schindler, inventor (to NASA) Issued 20 Oct. 1970 (Filed 4 Apr. 1968) 10 p Cl. 356-106; Int. Cl. G01b9/02
Sponsored by NASA
(NASA-Case-NPO-10320; US-Patent-3,535,041;
US-Patent-Appl-SN-718689) Avail: US Patent Office CSCL 09E

An apparatus suitable for sensing the direction of movement of an interferometer mirror is described. The apparatus comprises a high frequency oscillator for vibrating one of the mirrors with a small amplitude along the optical path. The output of a fringe detector is demodulated by a signal from the high frequency oscillator to derive a product signal. The average value of the product signal is 90 deg out of phase with the average fringe detector output, as both vary with the position of the movable interferometer mirror. These two signals which are 90 deg out of phase are delivered to a direction recongition circuit to sense direction of movement of the movable mirror. The direction recognition circuit drives a reversible counter which indicates the net movement of the movable mirror. Official Gazette of the U.S. Patent Office

N71-17656* Hayes International Corp., Huntsville, Ala.
SELF-BALANCING STRAIN GAGE TRANSDUCER Patent
Billy D. Babb, inventor (to NASA) Issued 20 Oct. 1970 (Filed 5 Jul. 1968) 4 p Cl. 73-88.5, Int. Cl. G01b7/18 Sponsored by NASA
(NASA-Case-MFS-12827; US-Patent-3,534,592;
US-Patent-Appl-SN-742818) Avail: US Patent Office CSCL 14B

A strain gage transducer of the bridge circuit type is described in which the values of components in the active branch and the ratio branch are chosen so as to initially unbalance the bridge circuit in a predetermined direction. A thermally responsive resistor is included in the ratio branch of the bridge circuit and a control circuit, responsive to bridge unbalance, is provided for heating. The resistance of the thermally responsive resistor varies in direction and amount to balance the bridge circuit.
Official Gazette of the U.S. Patent Office

N71-17657* Boeing Co., Seattle, Wash.
STRAIN SENSOR FOR HIGH TEMPERATURES Patent
E. Harold Evans, inventor (to NASA) Issued 20 Oct. 1970 (Filed 17 Oct. 1968) 6 p Cl. 33-148; Int. Cl. G01b3/16 Sponsored

by NASA
(NASA-Case-XNP-09025; US-Patent-3,534,479; US-Patent-Appl-SN-768473) Avail: US Patent Office CSCL 14B

A sensor for measuring strain in a specimen subjected to high temperatures is described. The apparatus comprises a water-cooled frame having a fixed post and a pivotably mounted leg, the post and leg having outer ends contacting the specimen. A crossarm fixed to the inner end of the leg has opposite ends that are supported by a pair of buckled columns. Strain gauges on the columns indicate the amount of any column buckling or straightening through pivoting of the leg. The crossarm, columns, and strain gauges are located within the water-cooled frame, and the pivotable leg extends through a long water-cooled tube to shield the inside of the frame from radiation emitted by the heated specimen. Official Gazette of the U.S. Patent Office

N71-17658* Brown Engineering Co., Inc., Huntsville, Ala.
INSPECTION GAGE FOR BOSS Patent
Wallace J. Jordon and James T. Whisenant, inventors (to NASA) Issued 20 Oct. 1970 (Filed 8 May 1968) 4 p Cl. 33-174; Int. Cl. G01b5/25 Sponsored by NASA
(NASA-Case-XMF-04966; US-Patent-3,534,480; US-Patent-Appl-SN-727480) Avail: US Patent Office CSCL 14B

A gage for checking the concentricity and squareness of sealing surfaces on an internally threaded boss relative to the pitch diameter of the threads is described. The gage includes a split collet threadable into the boss, an axially driven camming disc for locking the collet against rotation relative to the boss, and a sleeve rotatably mounted on the housing. The sleeve has a dial indicator mounted thereon which can be adjusted to contact the surfaces to be gaged whereby upon rotation of the sleeve and dial indicator any irregularities in the surfaces being gaged will be displayed on the face of the dial indicator.
Official Gazette of the U.S. Patent Office

N71-17659* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LOW TEMPERATURE FLEXURE FATIGUE CRYOSTAT Patent
Orvil Y. Reece, inventor (to NASA) Issued 9 Sep. 1969 (Filed 7 Oct. 1965) 5 p Cl. 73-15.4; Int. Cl. G01n25/02
(NASA-Case-XMF-02964; US-Patent-3,465,569; US-Patent-Appl-SN-493942) Avail: US Patent Office CSCL 13D

A flexure fatigue cryostat for testing of materials such as honeycomb panels at cryogenic temperatures is described. A vertically mounted, top-loading Dewar vessel is provided with upper and lower U-shaped yokes attached to the inner walls of the vessel. The ends of the legs of the yokes have opposed loading slots in which clamps are pivotally mounted. The test specimen is supported vertically at its ends by these clamps in a manner such that lateral movement is prevented, but upward movement and pivoting movement during flexure is allowed. Recriprocating flexure movement is imparted to the specimen intermediate its ends by means of a rod penetrating the front wall of the vessel, the end of the rod being clamped to the specimen.
Official Gazette of U.S. Patent Office

N71-17662* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTERFEROMETER SERVO SYSTEM Patent
Rudolf A. Schindler, inventor (to NASA) Issued 20 Oct. 1970 (Filed 4 Apr. 1968) 7 p Cl. 350-285; Int. Cl. G02f/34; Int. Cl. G01p9/02 Sponsored by NASA
(NASA-Case-NPO-10300; US-Patent-3,535,024; US-Patent-Appl-SN-718769) Avail: US Patent Office CSCL 09E

A servo system is disclosed for an interferometer of a type which includes a cat's eye retroreflector having a large primary mirror and small secondary mirror. The secondary mirror is mounted on a piezoelectric transducer for rapid movement relative to the primary mirror to enable a rapid change in the effective position of the retroreflector. Error correcting signals are passed through a crossover network so that only high frequency components are delivered to the secondary mirror transducer, while low frequency components are delivered to an actuator which moves the entire retroreflector including the primary and secondary mirrors.
Official Gazette of the U.S. Patent Office

N71-17701* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MICROBALANCE INCLUDING CRYSTAL OSCILLATORS FOR MEASURING CONTAMINATES IN A GAS SYSTEM Patent
James B. Stephens, inventor (to NASA) Issued 20 Oct. 1970 (Filed 7 Dec. 1967) 6 p Cl. 73-29; Int. Cl. G01n29/02 Sponsored by NASA
(NASA-Case-NPO-10144; US-Patent-3,534,585; US-Patent-Appl-SN-688805) Avail: US Patent Office CSCL 14B

An instrument for detecting the presence of condensible gas contaminating in a vacuum apparatus is described. The instrument consists of two piezoelectric quartz crystals mounted on a support fixed to a cryogenic container. One of the crystals is frequency sensitive to changes in mass while the other is frequency sensitive to changes in temperature. The latter crystal is shielded from the flow of condensible gas contaminants. Associated electronic equipment is provided to energize the crystals and to record changes in frequency. In a second variant the frequency response from the temperature crystal is converted to an analog signal and delivered to a variable radiation heater which projects an equal amount of radiation on each of the crystals to effectively balance the radiation load on the faces. Official Gazette of the U.S. Patent Office

N71-17741# Tufts Univ., Medford, Mass. Dept. of Electrical Engineering.
EXPERIENCES WITH BALLOON-BORNE TELESCOPES Final Report, 1 Feb. 1969 - 31 Jan. 1970
Alvin H. Howell 21 Sep. 1970 9 p
(Contract F19628-69-C-0167)
(AD-715299; AFCRL-70-0529) Avail: NTIS CSCL 3/1

A 24-inch telescope that had been designed and nearly completed under a preceding contract, was finished and used in four balloon flights. A number of improvements were incorporated in the system as the flight program developed. A major effort was also applied toward the design and initial fabrication of a new balloon-borne telescope of 50-inch size. Author (GRA)

N71-17756*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SPACECRAFT SUN SENSORS, NASA SPACE VEHICLE DESIGN CRITERIA (GUIDANCE AND CONTROL)
Jun. 1970 42 p refs
(NASA-SP-8047) Avail: NTIS CSCL 14B

Sensor systems that relate the line of sight to the geometrical center of the sun to a reference coordinate system associated with the spacecraft are examined. The physical characteristics and performance specifications for solar sensors are discussed. The electronics associated with the described sensor are considered only as interfaces. R.B.

N71-17870*# Raytheon Co., Alexandria, Va.
ANALYSIS OF MULTI-SENSOR DATA, 12 SEPTEMBER - 11 DECEMBER 1968
Edward T. Huffman, Charles A. Bay, and Richard F. Pascucci Dec. 1968 57 p refs Supported in part by NASA and Office of Emergency Preparedness Original contains color illustrations
(Contract DI-14-08-0001-11505)
(NASA-CR-116425; OEPR-3311) Avail: NTIS CSCL 14E

The results are presented of assessments made of multi-sensor imagery obtained, for the most part, from the interdisciplinary NASA Earth Resources Aircraft Program. The imagery studied was: black-and-white, color, color infrared, multiband, and thermal infrared. Specifically, the analysis was conducted for the purpose of: (1) determining the level of detail interpretable from each type of sensor record; (2) examining industrial, urban and other cultural activities and installations for unique spectral signatures; and (3) determining the applicability of each type of sensor record to functional and structural analysis and to the post-emergency analysis of earthquake damage. Author

N71-17949# Grumman Aerospace Corp., Bethpage, N.Y. Life Sciences Section.

DESIGNING A PHOTOMULTIPLIER NANOAMMETER

Martin Kesselman Feb. 1971 39 p refs

(RM-493) Avail: NTIS

An ammeter is described that is used to convert a photomultiplier current to a voltage suitable for tape recording or meter readout. The ammeter covers the range from 0.1 nanoamps to 10 microamps on six ranges, each a decade apart. The meter has 1000 percent over-ranging, providing a two-decade readout if this is necessary. The meter is designed to be 1 percent accurate and capable of operation outdoors in an environment of 0 to +35 C, a frequency response of the order of 0–100 Hz is required. The nanoammeter provides one volt output for range current with the capability of 10 volts output before saturation. The ideal current converter is introduced first to show its usefulness in a photomultiplier application. Drift and noise are considered next and finally transient behavior. After the theory has been outlined, the actual design is indicated, along with engineering compromises. The results of testing the finished unit are included to compare with theory. Author

N71-18032*# Norton Research Corp., Cambridge, Mass.

RESEARCH AND DEVELOPMENT PROGRAM ON THE USE OF COUNTING TECHNIQUES

F. L. Torney, Jr. and J. R. Roehrig Washington NASA Mar. 1971 51 p refs

(Contract NAS1-5347)

(NASA-CR-1747) Avail: NTIS CSCL 14B

The primary emphasis of this program was to reduce noise encountered in the multiplier of a quadrupole mass spectrometer when operating in an ion counting mode. This was to be done without sacrificing ion counting and collection efficiency. To this end, the use of an offset multiplier was investigated as a means of reducing certain elements of noise. In addition, two types of multipliers were investigated in order to obtain the maximum stable signal-to-noise ratio using ion counting techniques. A cold-cathode ion source/quadrupole mass spectrometer was used as a test instrument for these investigations. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N71-17109# Lincoln Lab., Mass. Inst. of Tech., Lexington.

PREPARATION OF THIN TARGETS WITH A LARGE SURFACE [IZGOTOVLENIYE TONKIKH MISHENEY S BOLSHOY POVERKHNOSTYU]

Y. Tomikova May 1970 8 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), no. 6, 1969 p 202–204

(Rept-(D-6)-70-06) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Two methods are described for producing thin targets on metal substrates. Using the method of mechanical deposition, films of Sm, Nd, Eu, Zn, Mo, Eu, and their separated isotopes were obtained from 0.5 to 7 mg/sq cm thick. Using the electrolytic method, targets of Ru and Os were produced on a copper substrate having a film thickness of 1 to 3 mg/sq cm. Author

N71-17172# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Flugtreib- und Schmierstoffe.

METHODS OF PREDICTING THE LIFE OF MOLYBDENUM SULFIDE, TUNGSTEN SULFIDE, AND POLYTETRAFLUORO ETHYLENE LUBRICATING LAYERS IN SLIDE BEARINGS AT 0.1 MICROTORR [METHODE ZUR VORAUSBERECHNUNG DER LEBENSDAUER VON MOS2-, WS2- UND POLYTETRAFLUORAETHYLEN-SCHMIERSCHICHTEN IN GLEITLAGERN BEI 0.1 MICROTORR]

Willy Hellwig and Guenter Spengler Jul. 1970 42 p refs In GERMAN; ENGLISH summary

(DLR-FB-70-28) Avail: NTIS; ZLDI Munich: 12.80 DM

Plain or phosphatized sliding surfaces were coated with molybdenum sulfide, tungsten sulfide, and Teflon to make slide bearings with dry lubricating films for ultrahigh vacuum work. The film life and friction coefficient were measured as functions of bearing load. The life was exponential within the flexible load range of films. By extrapolation from measurements at higher loads it was possible to predict the life of lubricating layers in ultrahigh vacuo at lower bearing loads. Author (ESRO)

N71-17184# Dow Chemical Co., Golden, Colo. Rocky Flats Div.

GAS COVERAGE FOR PIGMA WELDING

Eldon D. Brandon and Walter L. Bush 10 Nov. 1970 5 p refs

(Contract AT(29-1)-1106)

(RFP-1550) Avail: NTIS

A study was conducted to check differences in results when using argon and air to pressurize a welding chamber, and to determine the rate of torch gas flow required to give satisfactory arc shielding in pressurized inert gas metal-arc (PIGMA) welding. A series of gas metal arc welds was made on Type 1100 aluminum using 0.030-in.-diameter 718 aluminum electrode wire. The welds were made at 30 and 100 psia ambient pressure with 45, 60, 90, and 120 cubic foot hours of helium/argon shielding gas through the torch. The chamber atmospheres were air and argon. Although the welds made in compressed air exhibited a somewhat rougher surface and were oxidized, the welds were sound. The use of argon prevented the oxidation. At 30 psia pressure, 45 cubic foot hours torch gas coverage was adequate; at 100 psia pressure, at least 60 cubic foot hours was required. Author (NSA)

N71-17324*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TUNGSTEN AS A SLIPRING MATERIAL FOR USE WITH GALLIUM LUBRICATION IN ULTRAHIGH VACUUM

John S. Przybyszewski Washington Feb. 1971 22 p refs

(NASA-TN-D-6184; E-5954) Avail: NTIS CSCL 11H

Low speed (132 mm/min) gallium lubricated ground tungsten against tungsten (hemisphere on disk) slipring assembly experiments in vacuum showed that, although film formation appeared to be good, gallium bonding to the tungsten surface was mechanical (trapping in surface grooves). Gallium lubrication increased the

hemisphere wear by a factor of 4 and decreased disk surface damage compared to a similar dry experiment. The coefficient of friction was reduced from approximately 0.5 (dry) to approximately 0.28 (gallium lubricated). The range of observed electrical noise value was decreased from 4.5 to 125.0 milliohms PTP (dry) to 0.005 to 1.6 milliohms PTP (gallium lubricated). Removal of disk surface grooves by etching (to prevent gallium trapping) resulted in high electrical noise. Author

N71-17327*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF VELOCITY SLIP AT A POROUS BOUNDARY ON THE PERFORMANCE OF AN INCOMPRESSIBLE POROUS BEARING
Marvin E. Goldstein and Willis H. Braun Washington Feb. 1971 36 p refs
(NASA-TN-D-6181; E-5906) Avail: NTIS CSCL 13I

There is an effective slip in velocity of a fluid flowing over a porous surface. The effect of this slip on the performance of a porous bearing is established by obtaining solutions for the short bearing limit. The slip has a significant effect on bearing performance of small, high-speed, low-load bearings. A simple correction is given to the bearing friction formula to take into account the effects of slip. Author

N71-17328*# Hough Lab., Springfield, Ohio.
DEVELOPMENT OF MANUFACTURING PROCESS FOR LARGE DIAMETER CARBON-BASE MONOFILAMENTS BY CHEMICAL VAPOR DEPOSITION Final Report
R. L. Hough 11 Nov. 1970 40 p refs
(Contract NAS3-12429)
(NASA-CR-72770) Avail: NTIS CSCL 13H

Research was conducted to develop large diameter carbon monofilament in the 2.0 to 10.0 mil diameter range using the chemical vapor deposition process. Monofilaments have been synthesized in the 3.0 to 4.0 mil diameter range having measured ultimate tensile strength up to 541,000 psi and an elastic modulus of 27.7 $\times$ 10 to the 6th power psi. The high strength filaments were synthesized by alloying the carbon with nominally 25 to 35 mole % elemental boron. Other alloying agents, silicon or aluminum, did not prove satisfactory. Unalloyed carbon fibers were relatively weak, having maximum measured tensile strengths of ca. 160,000 psi. Author

N71-17329*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLLING-ELEMENT FATIGUE LIVES OF AISI T-1, AISI M-42, AISI 52,100 AND HALMO AT 150 F
Richard J. Parker, Erwin V. Zaretsky, and Marshall W. Dietrich Washington Feb. 1971 22 p refs
(NASA-TN-D-6179; E-5896) Avail: NTIS CSCL 13H

Rolling-element fatigue tests were run with 1/2-inch-(12.7-mm-) diameter balls of AISI 52100, AISI T-1, AISI M-42, and Halmo. Tests were run in five-ball fatigue testers at 800,000 psi at a temperature of 150 F (340 K). Care was taken to maintain constant all variables known to affect rolling-element fatigue life. The longest lives were obtained with AISI 52100. The difference between lives of Halmo and AISI 52100 is not statistically significant. The confidence that AISI 52100 is superior in rolling-element fatigue to AISI T-1 and AISI M-42 is 98 percent and > 99 percent, respectively. A trend is indicated toward decreased rolling-element fatigue life in alloys with increased total weight percent of such elements as molybdenum, chromium, vanadium, tungsten, and cobalt. AISI T-1, Halmo, and AISI M-42 show at least a 200 F (111 K) advantage over AISI 52100 in elevated-temperature hardness retention capability. Author

N71-17384*# Hydronautics, Inc., Laurel, Md.
SUMMARY OF AN INVESTIGATION OF TANDEM ROW HIGH HEAD PUMP INDUCERS Final Report
Robert J. Etter May 1970 24 p refs
(Contract NAS8-20625)
(NASA-CR-116500; TR-703-9) Avail: NTIS CSCL 13K

The suction specific speed is the parameter used to characterize the inlet operating conditions for a pump. For a given discharge, high suction specific speed results when either rotational speed is increased or NPSH is decreased. Both changes result in significant weight reductions when the pumps under consideration are fuel or oxidizer pumps in a liquid fueled rocket engine system. Prepumping stages called inducers are presently located ahead of the main fuel pumps. The inducers operate satisfactorily even with extensive cavitation and provide sufficient head rise so that the main pumps may operate in a noncavitating mode. Author

N71-17481*# Scientific Translation Service, Santa Barbara, Calif.
CENTRIFUGAL PUMPS
C. Pfleiderer Washington NASA Feb. 1971 10 p refs Transl. into ENGLISH from the book "Die Kreiselpumpen' Berlin, Verlag von Julius Springer, 1932 p 221–228
(Contract NASw-2035)
(NASA-TT-F-13465) Avail: NTIS CSCL 13K

The pressure head loss in water pumps of various designs is calculated. The presence of the clearance overpressure causes backflow of water into the suction chamber, the so-called clearance loss, at the seals of the inner and outer circumference of the impeller. Sealing appears primarily at the inner clearance. No effective barrier to the loss flow can be produced at the outer circumference, partly because of the wide leakage cross section which is related to the large circumference and the relatively wide clearance, and partly because of the short length of the seal which is required so that the impeller friction will not be too great. Some of the most common seal designs for the inner circumference are shown. Author

N71-17485*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME EFFECTS OF COLD WORKING BY HYDROSTATIC EXTRUSION ON MECHANICAL PROPERTIES OF HIGH-STRENGTH STEELS
Charles P. Blankenship Washington Feb. 1971 20 p refs
(NASA-TN-D-6186; E-5967) Avail: NTIS CSCL 11F

A 300-grade maraging steel and AISI 4340 were cold worked in various heat-treated conditions by hydrostatic extrusion. Maximum extrusion pressures ranged from 260 to 300 ksi for 50-percent reductions in area. Cold working and reaging increased the strength of the fully aged maraging steel about 50 ksi. AISI 4340, initially heat treated to R sub c 44, showed a 60-ksi increase in strength after cold working and retempering. In both steels, resolution and reprecipitation as a result of cold working and reaging or retempering contributed to the strength increases noted. Author

N71-17555*# Marquardt Corp., Van Nuys, Calif.
GASEOUS OXYGEN-GASEOUS HYDROGEN ROCKET ENGINE INJECTOR VALVE TECHNOLOGY Final Report
R. A. Lynch Dec. 1970 235 p refs
(Contract NAS9-10086)
(NASA-CR-114857; TMC-S-985) Avail: NTIS CSCL 13K

A comprehensive technique was developed for systematically performing trade-off studies of valve designs. A state-of-the-art survey was completed to assess the current status of metal bellows technology with respect to high performance valve requirements. A comprehensive analysis program was developed for predicting performance and physical characteristics of at least eight valve configurations as a function of rocket engine performance criteria.

The analytical program was substantiated by a concurrent design effort to document several sample applications. Parametric design curves were prepared for predicting valve performance and physical characteristics. Trade-off curves of various valve configurations, as a function of performance and physical characteristics, were prepared. A systematic approach for presenting and evaluating valve configurations for a specific application was developed and demonstrated. Detail design layouts were completed of valve configurations for two specific applications. Author

N71-17628* Hayes International Corp., Huntsville, Ala.
METHOD AND APPARATUS FOR CRYOGENIC WIRE STRIPPING Patent
Billy D. Babb, inventor (to NASA) Issued 21 Apr. 1970 (Filed 28 Mar. 1968) 6 p Cl. 225-1; Int. Cl. B23p19/02; Int. Cl. B26f3/00; Int. Cl. H02g1/12 Sponsored by NASA
(NASA-Case-MFS-10340; US-Patent-3,507,425; US-Patent-Appl-SN-716734) Avail: US Patent Office CSCL 13I

A method and apparatus are described for removing the plastic insulation from wire by dipping the wire into a cryogenic liquid to freeze the insulation and cause it to crystallize, breaking the frozen insulation by impacting it with cutters, and then stripping off the fractured insulation. The apparatus includes a programmer and a fully automatic device for lifting the wire out of the cryogenic liquid and impacting the wire between fixed and movable cutters, thus preparing the wire for stripping by hand or with a hand tool.
Official Gazette of the U.S. Patent Office

N71-17634# Dow Chemical Co., Golden, Colo.
PARAMETERS FOR PRESSURIZED INERT GAS METAL ARC WELDING OF ALUMINUM
Eldon D. Brandon 15 Oct. 1971 38 p refs
(Contract AT(29-1)-1106)
(RFP-1515) Avail: NTIS

The significance of various process parameters in pressurized inert gas metal arc welding was established. Specifically, the effects of arc voltage, wire speed, travel speed, and chamber pressure were determined. The measured responses were arc mode and stability, weld appearance, soundness, area, width, penetration, reinforcement, and depth-to-width ratio. Using predetermined combinations of parameters, bead-on-plate welds were made on an 8-inch diameter by 1-inch wall of a Type-1100 aluminum cylinder. The filler wire was a 0.030-inch diameter of Type-718 aluminum. The welding was performed in a pressure chamber with the cylinder in the horizontal-rolled position. After welding, the welds were X-rayed and visually and metallographically examined. The raw data of each response were treated using a multiple regression analysis technique. Author

N71-17647* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VACUUM DEPOSITION APPARATUS Patent
George D. Adams, inventor (to NASA) Issued 24 Mar. 1970 (Filed 1 Sep. 1966) 9 p Cl. 118-11; Int. Cl. B05c11/00; Int. Cl. C23c13/00
(NASA-Case-XMF-01667; US-Patent-3,502,051; US-Patent-Appl-SN-577115) Avail: US Patent Office CSCL 13A

An apparatus used to form thin film inductive windings is described. The apparatus comprises both a source of conductive and insulative coatings with appropriate masking to effect a continuous deposit of the various layers of the thin film inductor. A conical chamber is mounted above the coating sources and is divided into two separate passageways by a partition. The substrate to be coated is mounted above the coating sources and can be rotated into the appropriate position by a device pivotally mounted in the housing section of the apparatus. A vacuum is created within the apparatus and the coatings are heated and evaporated to form continuous alternate layers of conductive and insulative coatings upon the rotating substrate.
Official Gazette of the U.S. Patent Office

N71-17648* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
METAL VALVE PINTLE WITH ENCAPSULATED ELASTOMERIC BODY Patent
Robert K. Allgeier, Jr., inventor (to NASA) Issued 28 Apr. 1970 (Filed 17 Oct. 1968) 5 p Cl. 25 -358; Int. Cl. F16k25/00
(NASA-Case-MSC-12116-1; US-Patent-3,508,739; US-Patent-Appl-SN-768336) Avail: US Patent Office CSCL 13K

An elastomeric body having a predetermined configuration is completely encapsulated within one contoured end of a metal shaft which moves axially to meet and close an apertured, correspondingly contoured metal seat. The shaft and elastomeric body are deformed in relation to the mating contours of the seat and shaft which in turn is related to the length of axial travel of the shaft into the seat to provide a controllable, variable sealing force. The elastomeric body also acts to restore the original shaft contour when the shaft is retracted from the seat.
Official Gazette of the U.S. Patent Office

N71-17649* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
QUICK DISCONNECT LATCH AND HANDLE COMBINATION Patent
Lewis R. Coker and Charles A. MacKay, inventors (to NASA) Issued 1 Sep. 1970 (Filed 15 Jul. 1968) 4 p Cl. 248-360; Int. Cl. B65d25/28
(NASA-Case-MFS-11132; US-Patent-3,526,382; US-Patent-Appl-SN-744910) Avail: US Patent Office CSCL 13E

A quick disconnect latch and handle combination are described for mounting an article, such as an equipment container, on a wall or other supporting base. The device attaches to the article and provides a handle for manipulating the article and a latch that engages within holes in the supporting base to secure the article. The latch mechanism is operated with the hand while gripping the handle. Official Gazette of the U.S. Patent Office

N71-17650* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD AND APPARATUS FOR PRECISION SIZING AND JOINING OF LARGE DIAMETER TUBES Patent
Robert J. Schwinghamer and J. D. Bennight, inventors (to NASA) Issued 21 Apr. 1970 (Filed 8 May 1967) 13 p Cl. 29-517; Int. Cl. B23b11/00; Int. Cl. B21d26/14, 39/04
(NASA-Case-XMF-05114; US-Patent-3,507,034; US-Patent-Appl-SN-637882) Avail: US Patent Office CSCL 13E

A method and apparatus are described for portable high precision magnetomotive bulging, constricting, and joining of large diameter tubes. The method allows decremental, accurate changing of the diameter of very large tubes, as well as high quality joints obtained by either bulging or constricting overlapping ends of two tubes. The apparatus consists of a magnetomotive coil positioned either inside or outside of the tube and a nonconducting mandrel on the other side. The magnetomotive coil has square conductors which are recessed, and separated by an air gap, from the tube. The constricting coil has a split metal sleeve for withstanding hoop stress. The tube is insulated from the coil by a thin plastic sleeve. The power supply is an electrically floating system.
Official Gazette of the U.S. Patent Office

N71-17651* Goodyear Aerospace Corp., Akron, Ohio.
METHOD OF MAKING A FILAMENT-WOUND CONTAINER Patent
Clem B. Shriver, inventor (to NASA) Issued 20 Oct. 1970 (Filed 11 Aug. 1967) 6 p Cl. 156-172; Int. Cl. B31c9/00
Continuation-in-part of US Patent Appl SN-505765, filed 29 Oct. 1965 Sponsored by NASA
(NASA-Case-XLE-03803-2; US-Patent-3,535,179; US-Patent-Appl-SN-689336) Avail: US Patent Office CSCL 13H

A technique is described for fabricating a cryogenic storage container by covering a polystyrene foam mandrel with an impermeable material. The insulation is then assembled on the mandrel and wrapped with resin impregnated filaments. The filaments are cured to form a structural shell, and the winding mandrel is removed from the interior of the container. The insulation is made by encapsulating foam in a vacuum tight casing to prevent gas cryopumping. A bleeder ply is positioned between the foam and the casing to provide a conductance path, facilitating the removal of gases. Official Gazette of the U.S. Patent Office

N71-17652* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LINEAR MAGNETIC BRAKE WITH TWO WINDINGS Patent

Heinrich G. Kosmahl, inventor (to NASA) Issued 3 Feb. 1970 (Filed 12 Dec. 1966) 5 p Cl. 310-93; Int. Cl. H02k49/00
(NASA-Case-XLE-05079; US-Patent-3,493,797;
US-Patent-Appl-SN-601228) Avail: US Patent Office CSCL 09E

The braking system uses a pair of inductively coupled circuits. A primary coil is nonuniformly wrapped about a tubular core with a winding density which produces a constant force on a secondary coil. Official Gazette of the U.S. Patent Office

N71-17653* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FASTENER APPARATUS Patent

Charles C. Kubokawa, inventor (to NASA) Issued 20 Oct. 1970 (Filed 12 Dec. 1968) 7 p Cl. 85-3; Cl. 24-211, Int. Cl. F16b21/00; Int. Cl. F16b35/04
(NASA-Case-ARC-10140-1; US-Patent-3,534,650;
US-Patent-Appl-SN-783379) Avail: US Patent Office CSCL 13E

A releasable pin-type fastener is described which has an adjustable length and a toggle-type bulkhead engaging means for enabling quick engagement, release, and fastening operation. The fastener can be inserted through an aperture in a bulkhead far enough to allow the toggle to clear the aperture on the far side of the bulkhead, and threads are provided for secure attachment. The fastener has both high tensile and high shear strength. Official Gazette of the U.S. Patent Office

N71-17654* TRW Systems, Redondo Beach, Calif.

CONTROL VALVE AND CO-AXIAL VARIABLE INJECTOR Patent

Louis A. Rosales and Albert L. Young, inventors (to NASA) Issued 20 Oct. 1970 (Filed 21 May 1968) 8 p Cl. 239-416; Int. Cl. B05b7/12 Sponsored by NASA
(NASA-Case-XNP-09702; US-Patent-3,534,909;
US-Patent-Appl-SN-730734) Avail: US Patent Office CSCL 13K

A biliquid flow control valve was combined with a variable thrust injector into an integral compact device. The housing of the device includes a set of concentric cylinders which are joined by an annular plate which divides the housing into a set of valve chambers. An arcuate shaped protrusion is supported on each face of the plate. An annular flow control passage is formed in each valve chamber by means of a semitoroidal flexible diaphragm which is mounted to surround at least a portion of the protrusion. A set of injector passages are formed on each side of the inner concentric cylinder and a pintle head is mounted to face a biliquid injector orifice formed at the terminus of the inner cylinder. The outer surface of each diaphragm is attached to a cylindrical sleeve which is flexurally mounted for axial movement with respect to the housing. On movement of the sleeves, the flow rate is controlled by varying the gap between the protrusion and the diaphragm. On axial movement of the housing, the pintle gap is controlled by varying the space between the pintle head and the extremity of the biliquid injector. Official Gazette of the U.S. Patent Office

N71-17682*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PRELIMINARY FRICTION AND WEAR STUDIES OF COBALT-RHENIUM SOLID SOLUTION ALLOY IN AIR AND IN VACUUM

William A. Brainard and Donald H. Buckley Washington Feb. 1971 14 p refs
(NASA-TN-D-6165; E-5985) Avail: NTIS CSCL 20K

Friction and wear were measured for a cobalt-rhenium solid solution alloy with 12 weight percent rhenium in both air and vacuum at temperatures to 675 C. Friction coefficients for the alloy in vacuum were low (0.30) to 525 C, beyond 525 C, the friction coefficient increased with temperature to 1.2 at 675 C because of the crystal transformation from hexagonal-close-packed to face-centered-cubic. Wear at 625 C in vacuum was 200 times higher than at 20 C, where the alloy has a stable hexagonal-close-packed structure. The alloy exhibited slightly higher friction in air at 20 C, but friction decreased linearly with temperature, because of formation of low shear strength oxides, to a value less than 0.20 at 625 C. Author

N71-17685* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ELECTRICAL SPOT TERMINAL ASSEMBLY Patent

Charles D. Baker, inventor (to NASA) Issued 26 Aug. 1969 (Filed 15 Sep. 1967) 6 p Cl. 339-17; Int. Cl. H05k1/00; Int. Cl. H01r13/50 Sponsored by NASA
(NASA-Case-NPO-10034; US-Patent-3,464,051;
US-Patent-Appl-SN-668241) Avail: US Patent Office CSCL 13E

An electrical terminal is mechanically attached to a mounting plate which is adhered to an insulation plate by a layer of high temperature adhesive. This spot terminal assembly is mounted on a printed circuit board by a layer of adhesive which cures at ambient temperature. An electrical lead for connecting the terminal to a conductor on the printed circuit board is made of material having adequate electrical conductivity but low thermal conductivity to permit consecutive adjacent solder joints. Official Gazette of the U.S. Patent Office

N71-17686* Technidyne, Inc., West Chester, Pa.

METHODS AND APPARATUS EMPLOYING VIBRATORY ENERGY FOR WRENCHING Patent

Nicholas Maropis, William A. Wilson, and Herman T. Blaise, inventors (to NASA) Issued 1 Sep. 1970 (Filed 7 Dec. 1967) 10 p Cl. 29-428; Int. Cl. B23p11/00, 19/00, 19/04 Continuation-in-part of US-Patent-Appl-SN-674999, Filed 12 Oct. 1967 Sponsored by NASA
(NASA-Case-MFS-20586; US-Patent-3,526,030;
US-Patent-Appl-SN-688868) Avail: US Patent Office CSCL 13I

A wrench is described for applying vibratory energy primarily to mechanical fasteners which are elastically compliant along the radius vector so as to effect improved tightening or loosening of fasteners. The direction of the particle motion constituting the introduced vibration is essentially along the radius vector of the fastener to which the vibration is introduced. Provision is made for tightening the fastener to a predetermined specified torque level and for applying the requisite vibratory energy while simultaneously rotating the fastener an additional amount without extending the said torque level. Official Gazette of the U.S. Patent Office

N71-17687* Schjeldahl (G. T.) Co., Northfield, Minn.

ROTATING MANDREL FOR ASSEMBLY OF INFLATABLE DEVICES Patent

Sigvard J. Stenlund, Alfred J. Wendt, and John A. MacFadden, inventors (to NASA) Issued 28 Apr. 1970 (Filed 31 Mar. 1967) 9 p Cl. 156-510; Int. Cl. B32b31/04, 31/10; Int. Cl. B65b9/06 Sponsored by NASA
(NASA-Case-XLA-04143; US-Patent-3,508,999;
US-Patent-Appl-SN-628246) Avail: US Patent Office CSCL 13I

A rotatable, elongated, multisided mandrel for speeding up and simplifying the fabrication of inflatable space structures is described. The mandrel facilitates the accurate measurement, cutting, and assembling of an integral number of gores from lightweight sheet stock material, such as aluminum-Mylar laminate, to form an inflatable structure with a configuration of a solid of revolution. N.E.N.

N71-17688* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD OF LUBRICATING ROLLING ELEMENT BEARINGS Patent
Dean C. Glenn, inventor (to NASA) Issued 17 Mar. 1970 (Filed 28 Nov. 1967) 4 p Cl. 29-148.4; Int. Cl. B21d53/12
(NASA-Case-XLE-09527; US-Patent-3,500,525;
US-Patent-Appl-SN-686344) Avail: US Patent Office CSCL 11H

The bearing has rolling elements positioned by a retainer or cage fabricated from a porous metal. A solid lubricant is burnished on the components prior to use in ultrahigh vacuum environments. Official Gazette of the U.S. Patent Office

N71-17692* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRECISION STEPPING DRIVE Patent
Walter E. Kaspareck, inventor (to NASA) Issued 22 Sep. 1970 (Filed 7 Nov. 1968) 5 p Cl. 74-63; Int. Cl. F16h25/06
(NASA-Case-MFS-14772; US-Patent-3,529,480;
US-Patent-Appl-SN-774151) Avail: US Patent Office CSCL 13I

A device is described for driving rotationally and in precise increments a ring gear having internal teeth. A cam disk having a continuous cam groove in the surface is located centrally; driven gear and two plungers extend from the cam groove toward the internal teeth of the ring gear. A cam following roller is joined to each of the plungers, and as the cam disk rotates, the plungers are caused to reciprocate alternately into and out of wedging engagement with the ring gear teeth. Each reciprocating cycle of each plunger rotates the ring gear a precise amount.
Official Gazette of the U.S. Patent Office

N71-17693* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SEALED SEPARABLE CONNECTION Patent
Robert M. Bamford, inventor (to NASA) Issued 17 Mar. 1970 (Filed 15 Sep. 1967) 6 p Cl. 244-1; Int. Cl. B64g9/00
Sponsored by NASA
(NASA-Case-NPO-10064; US-Patent-3,501,112;
US-Patent-Appl-SN-668755) Avail: NTIS CSCL 11A

A thin wall metal tube is collapsed between mating edges of two connectors to provide a sealed joint. By applying high pressure fluid to the sealed interior of the tube, the tube expands to sever the means joining the connectors.
Official Gazette of the U.S. Patent Office

N71-17694* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INCREMENTAL MOTION DRIVE SYSTEM Patent
John H. Morecroft, inventor (to NASA) Issued 17 Mar. 1970 (Filed 17 May 1967) 11 p Cl. 318-22; Int. Cl. G05b11/01
Sponsored by NASA
(NASA-Case-XNP-08897; US-Patent-3,501,683;
US-Patent-Appl-SN-640450) Avail: US Patent Office CSCL 13I

An incremental motion drive system is presented; the driven member is subjected to two separate driving motions. The first is a continuous motion in a predetermined direction; the second motion is superimposed upon the first by means of an electromechanical transducer, so that the motion may be reversed, stopped, or otherwise altered. The incremental motion drive system has excellent utility when incorporated into a combination of interferometer system components.
Official Gazette of the U.S. Patent Office

N71-17695* Gulf General Atomic, San Diego, Calif. San Fernando Labs.
TUNGSTEN SEAL COAT Patent
James R. Lindgren, Alfred J. Weinberg, and Robert A. Holzl, inventors (to NASA) Issued 17 Mar. 1970 (Filed 27 Dec. 1968) 3 p Cl. 117-107.2; Int. Cl. C23c13/02 Sponsored by NASA
(NASA-Case-XNP-03704; US-Patent-3,501,337;
US-Patent-Appl-SN-605088) Avail: US Patent Office CSCL 11A

A two step process for cladding nuclear fuels with tungsten is reported. A thin seal coat of tungsten is deposited onto the fuel element in an evacuated chamber. This is followed by the vapor deposition of a final heavier main outer coating of tungsten over the seal coating. Official Gazette of the U.S. Patent Office

N71-17696* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYDRAULIC GRIP Patent
Fred F. Eichenbrenner and Walter Illg, inventors (to NASA) Issued 6 Jan. 1970 (Filed 26 Apr. 1968) Cl. 73-103; Int. Cl. G01n3/36
(NASA-Case-XLA-05100; US-Patent-3,487,680;
US-Patent-Appl-SN-724551) Avail: US Patent Office CSCL 13G

Details are given on an apparatus for clamping sheet stock specimens in a test machine, featuring the use of hydraulic clamps. The several types of clamps disclosed generally consist of a piston in a cylinder, with a rod extending through the pressure chamber, the end wall, the specimen, and clamping plate or plates, which are retained by a fastener so that pressurization of the chamber produces a clamping action.
Official Gazette of the U.S. Patent Office

N71-17803* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
METHOD FOR FORMING PLASTIC MATERIALS Patent
Joseph F. Naples, inventor (to NASA) Issued 6 Jan. 1970 (Filed 6 Jul. 1966) 5 p Cl. 264-92; Int. Cl. B29c17/04
(NASA-Case-XMS-05516; US-Patent-3,488,414;
US-Patent-Appl-SN-563648) Avail: US Patent Office CSCL 13H

A method is described for deep drawing of plastic products wherein uniform thickness of the finished article is required. The plastic sheet is heated until pliable, and then placed over the open cavity of a mold having a forming area and an excess trough area. The portion of the sheet overlying the excess trough area is then subjected to additional heat until the material in that area stretches out and almost touches the bottom of the cavity. Vacuum is then applied to the forming area and the sheet is caused to conform to the mold. The thickness of the plastic in the forming area remains constant, while any thin out occurs in the plastic lying in the excess trough area which will be trimmed off.
Official Gazette of the U.S. Patent Office

N71-17805* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RATCHET MECHANISM Patent
Dan H. Dane, inventor (to NASA) Issued 20 Oct. 1970 (Filed 6 Sep. 1968) 6 p Cl. 192-43.1; Cl. 81-63.1; Int. Cl. F16d13/06; Int. Cl. F16d23/12
(NASA-Case-MFS-12805; US-Patent-3,534,836;
US-Patent-Appl-SN-758082) Avail: US Patent Office CSCL 13E

A ratcheting mechanism comprising a housing, a socket member rotatably mounted therein and a number of paired sprag members pivotally mounted in spaced notches on the socket member is described. A control member mounted in the housing is rotated in either direction to engage and pivot a desired one of

each sprag pair away from the housing. The other sprag of each pair will permit rotation of the housing relative to the socket member in the direction of the pivoted sprag, but will jam if the housing is rotated in the other direction, thereby providing a ratcheting action between the housing and socket. A knob attached to one end of the control member for rotating the control member against the sprags is secured through a friction lock to a knob bolted to a shaft that is keyed to the socket member. Author

N71-17822* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MICROWAVE FLAW DETECTOR Patent

Lester Feinstein and Ronald J. Hruby, inventors (to NASA) Issued 6 Oct. 1970 (Filed 20 Mar. 1968) 8 p Cl. 324-58.5; Int. Cl. G01r27/04

(NASA-Case-ARC-10009-1; US-Patent-3,532,973; US-Patent-Appl-SN-714595) Avail: US Patent Office CSCL 09C

A flaw detecting system is described that uses microwave energy radiated toward the surface to be tested in a return-to-zero variation manner. The test surface modifies the reradiated pattern, and this modification is detected and correlated with an original reference pattern or with itself to determine the presence of flaws or irregularities on the surface.

Official Gazette of the U.S. Patent Office

N71-17832# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AUTOMATION OF TECHNOLOGICAL PROCESSES IN AIRCRAFT-ENGINE CONSTRUCTION

M. I. Evstigneev 10 Sep. 1970 275 p refs Transl. into ENGLISH of the book 'Avtomatizatsiya Tekhnologicheskikh Protsessov v Avia-Dvigatelestroyenii' Moscow, Izd-Vo Mashinostoyeniye, 1969 p 1-267

(AD-714858; FTD-MT-24-102-70) Avail: NTIS CSCL 13/8

The book expounds on questions of planning the technological processes of automated production. The systems and mechanisms of the automatic control of technological units and machine-tool lines are described. The methods and means of automating the machining and quality control of components and subassemblies of aircraft engines and the principles of setting up automatic machine-tool lines are examined, the technical and economic bases of the selection of rational methods of automating the technological processes in aircraft engine construction are presented. Author (GRA)

N71-18069# California Univ., Livermore. Lawrence Radiation Lab.

OPERATION OF A 12-INCH FAST GATE VALVE WITH A PRESSURE CARTRIDGE

P. R. Betten and P. M. Holl 26 Aug. 1970 8 p Sponsored by AEC

(URCL-50930) Avail: NTIS

A 12-inch fast gate valve operated with a pressure cartridge gives good closure times and requires only a simple firing system. A pressure seal is obtained with a full cartridge powder charge of 34.6 grams. This charge gave an energy utilization efficiency of a 61.3%. Closure time was 30.0 msec as compared to 29.0 msec with a helium system. Friction was the major loss, accounting for 35.7% of the available energy. Author (NSA)

N71-18132* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

APPARATUS FOR THE DETERMINATION OF THE EXISTENCE OR NON-EXISTENCE OF A BONDING BETWEEN TWO MEMBERS Patent

Wayman N. Clotfelter and Benjamin Bakston, inventors (to NASA) Issued 6 Oct. 1970 (Filed 26 Mar. 1968) 5 p Cl. 73-67.2; Int. Cl. G01h13/00

(NASA-Case-MFS-13686; US-Patent-3,531,982; US-Patent-Appl-SN-716183) Avail: US Patent Office CSCL 13H

A resonant inspection apparatus is described for determining the quality of a bond between a low density material and a high density material. The device includes a coupler consisting of a substance having a predetermined mechanical impedance approximating that of the low density material. An electro-mechanical transducer is used in conjunction with the coupler and is energized from the output of the variable frequency oscillator. The coupler is placed in close contact with the low density material so as to convey mechanical vibrations from the electro-mechanical transducer to the material and to receive reflected vibrations from it. Means are provided for varying the frequency of the oscillator until it coincides with one of the resonant frequencies of the low density material. In addition, means are provided for indicating the amplitude and frequency of the resonant frequency.

Official Gazette of the U.S. Patent Office

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N71-17036# Lincoln Lab., Mass. Inst. of Tech., Lexington.

DEFLECTION OF LASER BEAMS BY MEANS OF VIBRATING MIRRORS AT HIGH-FREQUENCIES FOR OPTICAL DATA RECORDING

M. Boerner et al 11 May 1970 30 p refs Transl. into ENGLISH from Wiss. Ber. AEG-Telefunken (West Germany), v. 42, no. 1, 1969 p 4-12

Avail: NTIS; National Translations Center, John Crerar Library, Chicago 60616

An analysis of various mechanical resonance systems, leading to an optimum deflection vibrator, is presented. The adaptation of mechanical vibrators is investigated, and the vibrator permitting the greatest angular deflection for comparable size is considered optimal. The angular deflections of torsional, flexural, and tension band resonators are compared. The choice of optical dimensions for a strip chart recorder is described with respect to beam focusing, recording a storage point, and recording a line of storage points. Details are given of a specific construction which has a storage density about 50 times greater than the limit of present-day magnetic storage methods. Read-out may be accomplished either by the scanning beam of a cathode ray tube or by a laser beam. N.E.N.

N71-17107# Lincoln Lab., Mass. Inst. of Tech., Lexington.

WAVEGUIDE LIGHT INTENSIFIER ON SEMICONDUCTOR LASERS [VOLNOUODNYY USILITEL SUETA NA POLUPROVODNIKOVYKH LAZERAKH]

L. A. Rivlin et al May 1970 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (USSR), v. 12, no. 10, 1969 p 1586-1587

Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A light intensifier in which the oscillator and the intensifier diodes are connected by a segment of a polyharmonic waveguide was investigated. The applicability of polyharmonic waveguides as elements of optical communication between semiconductor laser diodes was demonstrated. The specific characteristics of these waveguides are described, and several examples of optically coupled projection lasers are examined. Author

N71-17286# Idaho Nuclear Corp., Idaho Falls.
BIBLIOGRAPHY OF LASER PUBLICATIONS OF INTEREST TO EMISSION SPECTROSCOPISTS, 5
Jon M. Baldwin Aug. 1970 15 p refs
(Contract AT(10-1)-1230)
(IN-1425) Avail: NTIS

Thirty references are listed in connection with laser beam interactions with gases, seventy-seven for laser beam interactions with condensed phases, and thirty for applications of lasers to analysis. Many of the references in the second group concern plasma production by laser beams. NSA

N71-17271*# TRW Systems Group, Redondo Beach, Calif.
HOLOGRAPHIC INSTRUMENTATION STUDIES
Lee O. Heflinger and Robert E. Brooks Sep. 1970 133 p refs
(Contract NAS2-4992)
(NASA-CR-114274; TRW-12122-6007-R0-00) Avail: NTIS CSCL 20E

New methods of holographic interferometry, particularly with increased high sensitivity for the investigation of low pressure phenomena, and efforts to improve the coherence of the ruby laser are discussed. Techniques for wide angle interferometry without laser speckle, techniques of real time and double exposure holographic schlieren, interferometry through a turbulent boundary layer, the production of holographic range contours by two frequency operation of the pulsed ruby, and the comparison of the light sensitivity of holography and photography are described. Author

N71-17347*# ITT Aerospace/Optical Div., San Fernando, Calif.
A NARROW BEAM, BROAD BANDWIDTH, OPTICAL COMMUNICATION SYSTEM Interim Report
John R. Priebe 15 Sep. 1969 73 p refs
(Contract NAS8-20629)
(NASA-CR-103013) Avail: NTIS CSCL 20E

Modifications and evaluation of the optical communications system are discussed. The system equipment is briefly reviewed and its operation described. The modifications which were undertaken to improve and upgrade system performance are reported. These changes were made after extensive testing in the laboratory. A mathematical model was developed to judge system performance. Calculations are made for both ideal and noisy communications channels. The results of both the laboratory and the field tests are presented, and the facilities and the experiment techniques are described. Author

N71-17484# Joint Publications Research Service, Washington, D.C.
SOME GENERAL CHANGES IN THE BODY PRODUCED BY LASER RADIATION
A. I. Semenov et al 28 Jan. 1971 4 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 3, 1970 p 9-12
(JPRS-52274) Avail: NTIS

Within a few years after lasers were created, reports began to appear indicating that they have adverse effects on the body. Experimental studies on animals and separate observations on human beings who suffered accidental injuries showed that laser rays are particularly dangerous for the eyes. It was found that not only direct but also scattered-reflected radiation is dangerous. Later experiments revealed that laser radiation may cause pathological changes in other organs and tissues as well. Such lesions occur only after exposure to fairly high levels of energy and in small animals irradiated with a focused beam. It must be borne in mind, however, that the dose rate is steadily increasing, thereby enhancing the danger not only to such a vulnerable organ like the eye but to the skin and even the viscera and brain. The danger is also increasing from the use of lasers at comparatively low rates but high frequency of repetition of the pulses. Author

N71-17642# United Aircraft Corp., East Hartford, Conn. Research Labs.
VELOCITY DEPENDENCE OF THE GAIN OF A CO2 LASER
David C. Smith Dec. 1970 15 p refs
(Contract N00014-69-C-0308)
(AD-715316; UAR-J279) Avail: NTIS CSCL 20/5

Measurements of the small signal gain and saturation intensity of CO2-N2-He laser are made as a function of gas flow velocity over the range from approximately 0 to 10 m/sec. The small signal gain increases and the saturation intensity decreases with increased gas velocity. For intermediate flow velocities with a gas transit time in the laser of a second, the saturation intensity also depends on the direction of propagation of the amplifier beam with respect to the gas flow. The directional dependence is due to an axial gradient in the saturation intensity. The transit time of the gas in the 2.5 meter amplifier spans the time required for appreciable generation of CO by dissociation of the CO2, and the variation of the laser gain with velocity is attributed to the effects of CO on the inversion of the laser medium. Author (GRA)

N71-17643# Avco-Everett Research Lab., Everett, Mass.
FOCUSING EXPERIMENTS WITH A HIGH POWER N2/CO2 LASER Final Technical Report
James P. Reilly Nov. 1970 16 p refs
(Contract N00014-70-C-0429)
(AD-715139) Avail: NTIS CSCL 20/5

A high-power uniform electric discharge is used to produce laser action in a mixture of N2, CO2 and He. Stable and unstable resonator cavities have been used on this medium to extract large amounts of power in both single mode and multimode laser operation. At a given electrical power input and cavity coupling, no significant difference in power extraction from the cavity was measured between the stable and unstable resonators. When focused, the power output from the unstable resonator produced focal point spot sizes and energy densities consistent with near-diffraction limited single-mode operation. Author (GRA)

N71-17767*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION TO DETERMINE THE FEASIBILITY OF EMPLOYING LASER BEAM HOLOGRAPHY FOR THE DETECTION AND CHARACTERIZATION OF BOND DEFECTS IN COMPOSITE MATERIAL STRUCTURES Final Report
H. G. Aas, R. K. Erf, and J. P. Waters Feb. 1971 50 p refs
(Contract NAS1-9926)
(NASA-CR-111836) Avail: NTIS CSCL 20E

With ultrasonic excitation of the composite materials, time-average holography was shown to be capable of detecting disbonds as small as 0.5 cm square, determining the size and shape of disbonds, and detecting disbonds under as much as 1.25 mm of composite material bonded to aluminum and titanium. Thermal stressing of the composite materials is shown to be inferior to acoustical stressing and thermal mapping of the disbonds is shown to be inferior to time-average holography. It is concluded that the technique is an effective one for locating disbonds. Author

N71-17767# Avco-Everett Research Lab., Everett, Mass.
THE DEACTIVATION OF VIBRATIONALLY EXCITED CARBON DIOXIDE (001)BY COLLISIONS WITH CARBON MONOXIDE
W. A. Rosser, Jr., R. D. Sharma, and E. T. Gerry Sep. 1970 45 p refs
(Contract F29601-69-C-0060; ARPA Order 870)
(AD-715276; AERL-RR-349) Avail: NTIS CSCL 20/5

The rate constants associated with the deactivation of vibrationally excited CO2* (001) by collisions with CO have been experimentally determined from 300 to 900K by a laser

fluorescence method. The probability per collision of vibrational energy transfer from CO2* (001) to CO (v = 0) was computed by a theory involving long range forces. The calculated probabilities are in good agreement with the probabilities deduced from measurement of R1, the transfer rate constant in the exothermic direction. Author (GRA)

N71-17768# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
INVESTIGATION OF THE USE OF LASERS IN THE FAR INFRARED, INFRARED AND OPTICAL REGIONS Final Report, 1 Sep. 1966 - 31 Mar. 1969
Ali Javan 3 Jan. 1970 448 p refs
(Contract F19628-67-C-0074)
(AD-715040; AFCRL-70-0240) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/5

The report concerns frequency mixing experiments in the infrared and far infrared; Q-switching of molecular gas lasers and applications to the studies of energy transfer processes and molecular relaxations in the infrared; Short pulse transmission through absorbing media; Non-linearities of atomic and molecular resonances; Interaction of an intense laser radiation with matter; and Other experiments in the area of interaction of laser radiation with matter. GRA

N71-17772# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Electrophysics.
LAMB DIP SPECTROSCOPY AND CARBON DIOXIDE FREQUENCY STABILIZATION ON SULPHUR HEXAFLUORIDE
Paul Rabinowitz Jun. 1970 84 p refs
(Contract F44620-69-C-0047)
(AD-715314; PIBEP-70-065; PIBMRI-70-001; AFOSR-70-2204TR) Avail: NTIS CSCL 7/4

The Lamb dip, a phenomenon associated with the nonlinear absorption of a standing wave in an inhomogeneously broadened medium, has been usedas the basis of a new type of high resolution spectroscopy and as a sharp reference for stabilizing the frequency of a laser. The effect has been applied in a high resolution study of the absorption properties of the SF6 molecule at a wavelength of 10.6 microns. The dip has also been used to stabilize the frequency of a CO2 laser to the same line centers that were studied. In addition, a theoretical analysis has been made of the dependence of the Lamb dip on absorption length and intensity which agrees favorably with experimental results. An examination of the limitations of this technique for spectroscopy and frequency stabilization is presented. Suggestions for improvements in the experimental techniques and for refinements of the existing apparatus are included. Author (GRA)

N71-17791# Hughes Research Labs., Malibu, Calif.
DAMAGE THRESHOLD STUDIES IN LASER CRYSTALS: EXPERIMENTAL AND THEORETICAL RESULTS IN RUBY AND SAPPHIRE Semiannual Report
Concetto R. Giuliano, Robert W. Hellwarth, Le Verne D. Hess, and Gerald R. Rickel Jul. 1970 54 p refs
(Contract F19628-69-C-0277; ARPA Order 1434)
(AD-715252; AFCRL-70-0437- SAR-2) Avail: NTIS CSCL 20/5

The results of a number of experiments are presented as well as a summary of the theoretical work. Bulk damage thresholds for several ruby and sapphire samples from different sources are presented. The problem of surface damage is discussed, and qualitative comparisons between entrance and exit surface damage are made. Differences between the gross characteristics of bulk damage in ruby and sapphire are presented and discussed. The dependence of damage threshold on TiO2 doping and optical pumping is presented. The theoretical treatment deals with processes by which cold conduction electrons may damage the lattice before they gain enough energy to ionize their surroundings. It is shown that the energy that the conduction electrons absorb linearly from the optical beam is deposited almost immediately in the lattice and is of sufficient magnitude to form a rupturing shock wave. It is also shown that the photoexcitation of impurity levels is enhanced by the presence of conduction electrons. The presence of conduction electrons and excited impurities is likely to alter the refractive index significantly and affect the focusing (self or external) in a complicated way. Implications of these results for raising damage thresholds are discussed. Author (GRA)

N71-17847# Naval Research Lab., Washington, D.C.
APPLICATIONS OF OPTICAL PARAMETRIC UPCONVERSION TO IR VIEWING SYSTEMS
R. A. Andrews 13 Oct. 1970 13 p refs
(AD-715339; NRL-7154) Avail: NTIS CSCL 20/5

The use of parametric upconversion to convert IR images to the visible has been demonstrated by several investigators. This technique has possible application in real-time systems with IR active viewing, and also as a means of producing IR holograms for recording three-dimensional information. For these applications, special consideration must be given to resolution, conversion efficiency, laser pump and illuminator powers, image identification, atmospheric transmission, and nonlinear materials. Resolution is determined by the optical system employed, and it is a function of the mode structure of the pump radiation and the size of the nonlinear crystal. Conversion efficiency depends on the mode of operation, which in turn determines peak pump intensity. Available nonlinear materials and lasers currently limit the design of a practical system to a few optimum combinations. Image identification is a problem of object reflectivity, both spectral and diffuse, in the IR operating range, which is limited by atmospheric transmission. Considering all these factors, an IR viewing system is possible employing a Nd:YAG laser, HIO3, and low-light-level TV. Author (GRA)

N71-17860# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PROBLEMS IN THE THEORY OF LASER MODULATION Final Report
H. L. Fox 1 Oct. 1970 21 p refs
(Contract N00014-68-C-0199)
(AD-714895; BBN-2060) Avail: NTIS CSCL 20/5

The report discusses the problem of intrinsic internal modulation of a laser - modulation by altering the state of the active laser medium. Controlled modulation for information transmission and uncontrolled noise-producing modulations are considered. To demonstrate a correspondence-principle derivation of the classical laser equations of Lamb, it is shown that the lifetime distortions previously reported must be included in a quantum treatment. The problem of sound waves and time-dependent Zeeman-effect modulation is discussed. Author (GRA)

N71-17878*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A HIGH-RADIANCE LASER SYSTEM FOR LUNAR RANGING
C. G. Lehr, M. R. Pealman, M. R. Wolf, J. A. Monjes, and W. F. Hagen Dec. 1970 3 p refs
(Contract NASw-2014)
(NASA-CR-116423; SAO-011-67A) Avail: NTIS CSCL 20E

A transportable laser system for lunar ranging is described. It can be used at any astronomical observatory where a 1.5-m telescope is available. Since this telescope is used for the returned signal only, its use for other purposes is not affected significantly. The transportable system uses a high-energy, single-mode, neodymium-glass laser whose frequency-doubled wavelength is 530 nm. Because the laser's divergence is very low, an atmospherically

limited beam-width can be achieved with optics only 0.2 m in diameter. An initial phase of the program, concerned with ranging to near-earth satellites, is also described. For this application, a 5-cm coude system is used to point the laser beam. It uses a separate 12-cm receiving telescope. Author

N71-18033# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
SPECTRAL COINCIDENCES BETWEEN EMISSION LINES OF THE CO LASER AND ABSORPTION LINES OF NITROGEN OXIDES
R. T. Menzies, Nicholas George, and M. L. Braumik 18 Aug. 1970 16 p refs
(Grant AF-AFOSR-1492-68)
(AD-715293; AFOSR-70-2643TR) Avail: NTIS CSCL 7/4

Several spectral coincidences between carbon monoxide laser emission lines and absorption lines of NO and N2O4 have been observed, and absorption measurements have been taken. These data are presented and discussed along with similar spectral coincidence observations made previously using the helium-neon and iodine lasers. Other coincidences between CO laser lines and NO2 absorption lines are predicted from a study of recently available high resolution spectroscopy literature. Due to the narrow linewidths of gas laser lines, the coincidences reported here can be applied to the selective sensing of these constituents in the atmosphere. Author (GRA)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N71-16942# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPTICAL PROPERTIES OF ALUMINUM EVAPORATED IN AN ULTRAHIGH VACUUM BETWEEN 500 AND 1400A
A. Daude et al 25 May 1970 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Ser. B (Paris), v. 269, no. 18, Nov. 1969 p 901-904
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The reflective power of aluminum films evaporated in an ultrahigh vacuum is measured for the 500-1400 angstrom region. The optical constants are determined between 900 and 1400 angstroms with the aid of the Kramers-Kronig method, and between 500 and 900 angstroms (a) by the critical angle method and (b) with the aid of Fresnel equations relative to a transparent film on an absorbent substrate. The position of the volume plasmon is specified and the existence of a surface plasmon is confirmed. Author

N71-16943# Lincoln Lab., Mass. Inst. of Tech., Lexington.
NEUTRON-DIFFRACTION INVESTIGATION OF ORDERED PHASES IN THE SYSTEM TITANIUM-OXYGEN [NEYTRONOGRAFICHESKOYE ISSLEDOVANIYE UPORYADOCHENNYKH FAZ V SISTEME TITAN-KISLOROD]
L. Ye. Fykin et al May 1970 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), vol. 191, no. 1, 1970 p 96-99
((D-11)-70-13) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The solubility of oxygen in alpha-titanium was estimated at 32 at. percent. Recent investigations have shown that in this region of concentrations there is no smooth change in properties such as electrical resistance, thermal emf, microhardness and rate of oxidation. According to the data on the curves of these properties plotted against the composition of protractedly annealed alloys, the existence of two singular points was noted which correspond to compositions of 14.3 and 25 at. percent oxygen. These singular points correspond to compositions of the suboxides Ti6O and Ti3O. The methods of x-ray structural and electron-diffraction analysis were used to detect the presence of an ordered structure on compounds of Ti6O, Ti3O, and Ti2O. Author

N71-17009# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ELECTRODEPOSITION OF ALUMINUM FROM THE ALUMINUM CHLORIDE-LITHIUM ALUMINUM HYDRIDE-TETRAHYDROFURAN BATHS
N. Ishibashi et al 9 Jun. 1970 12 p refs Transl. into ENGLISH from Denki Kagaku (Japan), v. 37, no. 1, 1969 p 73-77
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

From a hydride-type electrolyte bath using tetrahydrofuran (THF) as a solvent, a coherent, silver-white deposit of aluminum was obtained at AlCl3-to-LiAlH4 molar ratios from 3:1 to 1:2, temperatures of 20 to 60 C, and current densities of 1 to 3 A/dm squared. Aluminum dissolved from the anode was electrodeposited on a cathode having a purity of more than 99.99% in the THF bath. The addition of polyvinyl chloride to the bath effected the deposition of mirror-like glossy aluminum. Electric conductance of the bath was also measured with various concentrations of the solutes. The changes of the conductance with varying molar ratios of aluminum chloride to lithium aluminum hydride suggests the formation of different kinds of complex species from those in a diethyl ether solvent bath. Author

N71-17013# Iowa State Univ. of Science and Technology, Ames.
MAGNETIC FORM FACTOR OF THULIUM AND TERBIUM METALS
Torben Otto Brun (Ph.D. Thesis) Oct. 1970 95 p refs
(Contract W-7405-eng-82)
(IS-T-387) Avail: NTIS

The magnetic form factors of thulium and terbium single crystals were measured with polarized neutrons. The form factor of thulium was measured at 4.2 K in a magnetic field of 10 kOe applied parallel to the c-axis. The magnetic structure of thulium at 4.2 K and in low fields (less than 28 kOe) applied parallel to the c-axis is an antiphase domain structure with a net ferromagnetic moment parallel to the c-axis. The magnitude of the moment is 1 micron sub B per atom, and its magnetic form factor was determined. The form factor of terbium was measured at 298 K and in a magnetic field of 22 kOe applied parallel to both the a- and the b-axis. Terbium is paramagnetic at 298 K, and the magnitude of the induced moment in a field of 22 kOe is 0.8 micron sub B per atom for the two directions of the field. Within the experimental uncertainty, the form factors for the directions of the magnetic field were identical. Theoretical form factors were calculated for both thulium and terbium using the 4f wave functions of Freeman and Watson. A comparison between the theoretical and experimental form factors indicates that the free-ion wave functions of Freeman and Watson are too contracted for both metals. Author (NSA)

N71-17124# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STATE DIAGRAM OF THE SYSTEM Dy2O3-Cr2O3 [DIAGRAMMA SOSTOYANIYA SISTEMY DY2O3-CR2O3]
A. V. Shevchenko et al May 1970 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorg. Mater. (USSR), v. 5, no. 12, 1969 p 2128-2132

Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The binary system Dy_2O_3-Cr_2O_3 was studied in an argon atmosphere in the temperature range from 1600 to 2400 C. Based on data of X-ray investigations of the samples, subjected to various heat processes, a state diagram is constructed. It was established that one congruently melting compound is formed in the system with a 1:1 structure and a melting point of 2320 + or − 30 C. The dysprosium chromite is identified radiographically in compositions with a content from 5 to 95 mol.% chromium oxide. Using differential thermal analysis the phase transitions in the area of the system enriched with dysprosium oxide were investigated. Temperature of the polymorphic transitions C yields B and B yields H (with heating) are equal to 1950 + or − 10 and 2130 + or − 20 C were established. The transition C yields B has a temperature hysteresis near 100 C. E.M.C.

N71-17243# Stanford Univ., Calif. Dept. of Materials Science.
APPLICATION OF CONTROLLED ELECTROMAGNETIC FORCES DURING SOLIDIFICATION OF TYPE 304 STAINLESS STEEL Quarterly Progress Report, 1 Jun.–30 Sep. 1970
O. D. Sherby and W. A. Tiller 1970 4 p
(Contract AT(04-3)-326)
(S4-326-P-29-5) Avail: NTIS

The primary thrust of the experimental investigation of the application of controlled electromagnetic forces to stainless steel melts during solidification was directed at obtaining comparative mechanical properties and at scale-up of the study to 25-pound samples. A series of mechanical properties tests was devised which utilized small samples from the 1/2 pound ingots available and several tests made of both stirred and unstirred specimens. Design, parts fabrication, ordering of control systems components, and some assembly of the 25-pound ingot furnace were completed. Author

N71-17244# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
HOMOGENIZATION OF URANIUM-BASE NIOBIUM ALLOYS
Ross J. Jacks and Clifford V. Kangas 13 Oct. 1970 9 p refs
(Contract AT(29-1)-1106)
(RFP-1582) Avail: NTIS

Three types of niobium segregation are considered in uranium-base niobium alloys: dendritic coring, macrobanding, and gross-ingot segregation. The origin and nature of these inhomogeneities are discussed, as are procedures for their identification and elimination. Author (NSA)

N71-17245# Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 8, NO. 3 Bimonthly Technical Progress Review
Jun. 1970 35 p Sponsored by AEC
(BNL-50258) Avail: NTIS

Brief reviews are presented on information associated with liquid metal thermodynamics, fluid dynamics, heat transfer, corrosion, instrumentation, chemistry, component design, fabrication methods, safety, and metal purification. NSA

N71-17320*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL EXPANSION OF SOME NICKEL AND COBALT SPINELS AND THEIR SOLID SOLUTIONS
Isidor Zaplatynsky Washington Feb. 1971 15 p refs
(NASA-TN-D-6174; E-5836) Avail: NTIS CSCL 11F

Thermal expansion of spinel bars representing the binary systems nickel chromate-cobalt chromate, nickel chromate-nickel aluminate, and cobalt chromate-cobalt aluminate was measured in the 25 to 1050 C temperature range. The coefficients of expansion were found to have values characteristic of other refractory oxides. The $CoCr_2O_4$, $NiCrAlO_4$, and $NiCr_{(0.5)}Al_{(1.5)}O_4$ expanded approximately in a linear fashion. The latter had the lowest average coefficient at 500 C, and $Ni_{(0.25)}Co_{(0.75)}CrO_4$ had the lowest at 1000 C. Qualitative observations indicated that chromia-rich spinels exhibited much lower electrical resistivity than spinels containing alumina. Author

N71-17348*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLE OF HYDROGEN IN HOT-SALT STRESS-CORROSION OF A TITANIUM ALLOY
Hugh R. Gray Washington Feb. 1971 30 p refs
(NASA-TN-D-6188; E-5960) Avail: NTIS CSCL 11F

Corrosion-produced hydrogen was confirmed as the embrittling species during hot salt, stress corrosion of titanium alloys. Local concentrations of hydrogen of several thousand ppm were measured on a microscopic scale. These local hydrogen contents were substantially greater than the average bulk values (100 ppm) measured in salt-corroded specimens. Concentrations of hydrogen similar to the measured local values were charged into as-received Ti-8Al-1Mo-1V alloy specimens. These charged specimens were brittle when tensile tested at 800 F, as were the hot salt stress-corroded specimens. Author

N71-17349# Los Alamos Scientific Lab., N.Mex.
DETERMINATION OF 0.01 TO 1.0 PER CENT OF TITANIUM, ZIRCONIUM, HAFNIUM, NIOBIUM, TANTALUM, MOLYBDENIUM, AND TUNGSTEN IN URANIUM ALLOYS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
R. D. Gardner, A. L. Henicksman, and W. H. Ashley Oct. 1970 6 p refs
(Contract W-7405-eng-36)
(LA-4529) Avail: NTIS

The elements can be determined singly or in any simultaneous combination by analysis of a single solution. The procedure involves the dissolution of 1-g alloy samples in hydrochloric acid–hydrogen peroxide with small additions of hydrofluoric acid and nitric acid, dilution to 25-ml volume, and direct atomic absorption analysis. This very direct procedure is made possible by the fact that the uranium effectively suppresses interelement atomic absorption effects as well as enhancing the sensitivities of the individual elements. Suitable instrument settings for each element are given. The measurement coefficient of variation generally is better than 1% at the 1% (by weight) alloy level, better than 3% at the 0.1% alloy level, and except for niobium and hafnium, better than 7% at the 0.01% alloy level. Author (NSA)

N71-17390# National Gas Turbine Establishment, Pyestock (England).
FIBRE STRENGTHENED NICKEL-BASE ALLOY
A. W. H. Morris and A. Burwood-Smith *In* AGARD High Temp. Turbines Jan. 1971 15 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

The development and application of high temperature composites for gas turbine blading is discussed. Of the currently available reinforcements examined, only tungsten-5% rhenium wire affords acceptable stability in nickel-base alloys and a satisfactory increase in stress-rupture strength, but only by incurring a weight penalty. The maximum volume fraction reinforcement is controlled by composite density and blade geometry; at the low levels imposed the advantage of reinforcement is controlled by composite density and cooled blade. If adopted, fibre reinforcement is likely to be used in solid blades in engine stages where cooling is prohibitive and then only as a selected area reinforcement. Indeed

the whole question of application may rest on the thermal fatigue behavior. Laboratory tests on cylindrical specimens indicate very poor thermal fatigue crack resistance. Application of the newer low density single crystal alumina fibre is also discussed. Author

N71-17393*# Solar, San Diego, Calif.
THE COMPOSITION, MICROSTRUCTURE AND PROTECTION AFFORDED BY SEVERAL COMMERCIAL COATINGS ON TWO NICKEL-BASE ALLOYS
A. R. Stetson and V. S. Moore *In* AGARD High Temp. Turbines Jan. 1971 56 p refs (See N71-17372 07-28)
(Contract NAS3-9401)
(NASA-CR-116374) Avail: NTIS CSCL 11F

Six commercially available aluminide coatings were evaluated by simulated turbine environmental testing. The environment was the combustion products of JP-5 fuel and air at 0.85 Mach. Coating performance was assessed by weight change and metallographic methods. Electron microprobe X-ray analyses and, to a limited extent, X-ray diffraction were carried out to identify phases and define compositional differences which could be related to performance. Types of aluminide coatings included in this evaluation program were those containing significant quantities of: (1) silicon; (2) chromium applied either before or after the aluminum; and (3) ceramic material. Coatings were also represented that were hyper- and hypo-stoichiometric in the betaNiAl system. In general, the coatings with the greatest initial aluminum reservoir (thickness) provided the greatest protection. Hyper- rather than hypo-stoichiometric coatings appeared to provide longer protection at the maximum test temperature. The substrate also influenced coating performance with the coatings on B1900 showing consistently better performance than coatings on IN-100. Author

N71-17409*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLLING-ELEMENT FATIGUE LIVES OF FOUR M-SERIES STEELS AND AISI 52, 100 AT 150 F
Richard J. Parker, Erwin V. Zaretsky Washington Feb. 1971 23 p refs
(NASA-TN-D-7033; E-5887) Avail: NTIS CSCL 11F

Rolling-element fatigue studies were performed with 1/2-inch-(12.7-mm) diameter balls of AISI M-1, M-2, M-10, M-50, and 52100. Tests were run in five-ball fatigue testers at 800,000 psi and at a temperature of 150 F (340 K). Care was taken to maintain constant all the variables known to affect rolling-element fatigue life. The longest lives were obtained with AISI 52100. Ten-percent lives of the other materials ranged from 27 to 68 percent of that obtained with AISI 52100. Lives of different heat treatment lots of the same material differed by factors as great as two. There was no significant difference among the ability of AISI M-50, M-10, and M-2 to maintain hardness at elevated temperatures. Author

N71-17461*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF COLD WORK AND AGING ON THE SUBSTRUCTURE AND PRECIPITATION PHENOMENA IN THE COBALT-BASE ALLOY L-605
Gary D. Sandrock and Charles W. Andrews Washington Feb. 1971 28 p refs
(NASA-TN-D-7051; E-5959) Avail: NTIS CSCL 11F

A thin-foil electron microscopy study was made of the cobalt-base alloy L-605 in four conditions: mill-annealed, mill-annealed and cold-worked, mill-annealed and aged, and mill-annealed, cold-worked, and aged. Cold-working produced bands of extended dislocations on two or more octahedral slip systems, one predominant; their density increased with the degree of cold work. Aging collapsed nearly all extended dislocations. Cold-working prior to aging promoted intragranular nucleation, producing a more uniform distribution of precipitation. Severe cold-working plus aging produced evidence of partial recrystallization. Author

N71-17519# National Materials Advisory Board, Washington, D.C.
TRENDS IN USAGE OF ANTIMONY
Dec. 1970 123 p refs Sponsored in part by Bureau of Mines
(Contract GS-00-DS-(P)-64008)
(NMAB-274) Avail: NTIS

The fastest growing areas of primary antimony demand are as flame retardants in plastics (12.4 percent annual growth) and as catalysts (11.6 percent annual growth). The annual growth rate (5.8 percent), projected to 1975, for total antimony demand is exceeded by the growth rates of all flame retardants (9.5 percent), colors (8.2 percent), and dye fixatives (7.0 percent). Total metallurgical usage of antimony is expected to grow at 1.5 percent per year, a decreasing rate of demand. However, batteries are projected to continue at a 3.0 percent annual growth rate, a relatively steady demand. Author

N71-17633# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
ELECTROMAGNETIC GENERATION OF ULTRASOUND IN METALS
W. D. Wallace Aug. 1970 47 p refs
(Contract AT(30-1)-2150)
(NYO-2150-63) Avail: NTIS

Electromagnetic generation and detection of ultrasonic waves in metals is a technique which may be used to generate and detect ultrasound at megahertz frequencies without making physical contact with the metallic surfaces. Among areas of potential application suggested for electromagnetic generation is the field of ultrasonic nondestructive testing of metals. Results obtained from recent systematic investigations at megahertz frequencies have made it possible to characterize electromagnetic generation in terms of the physical properties of metals, ultrasonic frequency, and temperature. Electromagnetic generation in very pure metals at liquid helium temperatures is also discussed. Author

N71-17669*# Pratt and Whitney Aircraft, East Hartford, Conn.
EVALUATION OF ADVANCED SUPERALLOY PROTECTION SYSTEMS Final Report
F. P. Talboom, R. C. Elam, and L. W. Wilson 2 Dec. 1970 73 p
(Contract NAS3-12415)
(NASA-CR-72813; PWA-4055) Avail: NTIS CSCL 11F

Eleven coating compositions based on the Co-Cr-Al-Y system were applied to nickel-base alloy test specimens by electron beam vapor deposition. Coating composition was optimized through ballistic impact, furnace oxidation, and long-term rig oxidation tests. Appropriate metallographic, X-ray diffraction, and electron beam microprobe analyses were conducted. Two coating compositions capable of protecting a nickel-base alloy from excessive oxidation at a temperature of 2000 F (1366 K) were additionally characterized by tensile and stress-to-rupture tests. Four compositions demonstrated oxidation resistance more than three times that of comparison aluminide coatings in burner rig tests. The two coating compositions produced no adverse effect on the mechanical properties of the base metal. Author

N71-17683*# General Electric Co., Cincinnati, Ohio. Space Div.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, 15 Jul. – 15 Oct. 1970
R. W. Harrison and J. P. Smith 12 Nov. 1970 64 p refs
(Contract NAS3-6474)
(NASA-CR-72818; GESP-562; QPR-22) Avail: NTIS CSCL 11F

An evaluation of the T-111 Rankine system corrosion test loop was conducted. Metallographic specimens were examined from twenty-one selected areas of the loop. Microprobe analysis and microhardness measurements were performed on areas which showed anomalies in microstructure or chemical analysis. The microstructures were compared with pretest microstructures to delineate any changes that occurred as a result of the test exposure. All specimens were nickel plated prior to mounting to maintain edge retention. In addition to the T-111 specimens from the loop, samples were also examined from the nozzles and blades of selected stage turbine simulators. The results of the evaluation indicate possible minor alkali metal attack but no area of gross corrosion. In general, microstructural changes were readily correlated with changes in interstitial content of the T-111 alloy. D.L.G.

N71-17765# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF WEAR RESISTANCE OF AUSTENITIC MANGANESE CAST IRON DURING SLIDING FRICTION WITHOUT A LUBRICANT

Li Bon-Gir 18 Aug. 1970 15 p refs Transl. into ENGLISH from Tr. Tadzhiksk. Selskokhoz. Inst. (USSR), v. 13, 1968 p 151–156
(AD-714789; FTD-MT-24-98-70) Avail: NTIS CSCL 11/6

A study was made of the wear resistance of an austenitic Mn cast iron contg. total C 3.50, combined C 1.12, graphitic C 2.38, Mn 10.67, Si 3.69, P 0.135, and S 0.021 percent in conditions of sliding friction without lubricant under a specific pressure of 2.5-35.0 kg/sq cm, the rollers being of steel 45 G2 (C 0.40-0.50 and Mn 1.4-1.8 percent). At low specific pressures, i.e. 2.5-12.5 kg/sq cm, Mn cast iron is the as-cast condition has the greatest wear resistance and the steel roller the lowest. In the specific pressure range 12.5-35.0 kg/sq cm, the wear of the cast iron and the roller increase smoothly at first and then abruptly. The coefficient of friction in the low specific pressure region decreases, with increasing load, from 0.750 to 0.540. In the 12.5-35.0 kg/sq cm range the Mn cast iron has the maximum wear resistance after quenching, the roller wearing less than the cast iron. The coefficient of friction for these specific pressures begins to increase up to 0.870 and then with increasing load decreases to 0.660. At low specific pressures, 2.5-12.5 kg/sq cm, Mn cast iron, after annealing and quenching, possesses the least wear resistance. At high specific pressures, 12.5-35.0 kg/sq cm, annealed and quenched Mn cast iron has a wear resistance intermediate between quenched cast iron and as-cast cast iron. The roller showed little wear as compared with the cast iron. The coefficient of friction, at specific pressure of 20.0-35.0 kg/sq cm with an increase in load decreased from 0.826 to 0.616. Author (GRA)

N71-17804# Michigan State Univ.

TRANSPORT AND DEFECT PROPERTIES OF THIN METALLIC WIRES Progress Report, Sep. 1969–Sep. 1970

Jack Bass 30 Sep. 1970 29 p refs
(Contract AT(11-1)-1247)
(COO-1247-21; PR-8) Avail: NTIS

The following studies are reported: (1) quenching of platinum and tungsten vacancies and positron annihilations; (2) thermopower in magnetic fields; and (3) thermopower measurements on nickel near its phase transition. G.G.

N71-17826# Naval Intelligence Command, Alexandria, Va. Translation Div.

CORROSION RESISTANCE OF TITANIUM ALLOYS

F. N. Tavadze et al 19 Nov. 1970 6 p Transl. into ENGLISH from the Russian
(AD-715254; NIC-TRANS-3138) Avail: NTIS CSCL 11/6

Titanium has good resistance to corrosion in sea water, has high strength, and a low specific weight, so has wide-ranging future prospects for use in shipbuilding. Titanium is very widely used as a shipbuilding material. Author (GRA)

N71-17831# Army Foreign Science and Technology Center, Washington, D.C.

THERMOMECHANICAL TREATMENT OF METALS AND ALLOYS. VOLUME 1: THERMOMECHANICAL TREATMENT OF ALLOYS

M. S. Bernshtein 15 Oct. 1970 288 p refs Transl. into ENGLISH of the book 'Termomekhanicheskaya Obrabotka Metallov i Splavov. Tom Pervyi: Termomekhanicheskaya Obrabotka Splavov' Moscow, Metallurgiya Publishing Office, 1968 288 p
(AD-715295; FSTC-HT-23-788-70) Avail: NTIS CSCL 13/8

Contents: Effect of thermomechanical treatment on properties of alloys; Hardening by means of programmed loading; Thermomechanical treatment of alloys based on copper, aluminum, and magnesium; Thermomechanical treatment of heat-resistant austenitic alloys. GRA

N71-17844# Syracuse Univ., N.Y. Dept. of Chemical Engineering and Metallurgy.

THE SIGNIFICANCE OF MATERIAL DUCTILITY TO THE RELIABILITY AND LOAD CARRYING CAPACITY OF PEAK PERFORMANCE STRUCTURES Final Report, 1 Jul. 1969–30 Sep. 1970

Volker Weiss, Ravinder K. Ahuja, Jin-Long Sheu, and John G. Sessler Nov. 1970 65 p refs
(Contract N00019-70-C-0044)
(AD-715320; MET-VW-1810-F1170) Avail: NTIS CSCL 11/6

The fracture ductilities were determined as a function of stress state for Al 2024-T4, Al 7075-T6, 4340 (51 Rc) steel, Ti-6Al-6V-2Sn, annealed and Ti-16V-2.5 Al, solution treated. An attempt was made to correlate the fracture ductility values of these materials to their notch sensitivity and fracture toughness. For the stress states investigated (sigma sub 3 = 0) minimum fracture ductility values were observed for balanced biaxial tension, sigma sub 1 = sigma sub 2, for all materials studied, rather than for the plane strain condition, i.e. sigma sub 2/sigma sub 1 = 1/2 as predicted by a critical normal fracture stress criterion. Notch tensile test series were completed for Al 7075-T6 and Ti-6Al-6V-2Sn, annealed. The limiting local fracture strains, near the notch root, were found to be very close to the minimum fracture ductility values (sigma sub 1/sigma sub 2 = 1/1) found for these materials. Test programs to determine the notch sensitivity and fracture toughness for ultra strength materials, as well as their relationships to material ductility are continuing. Author (GRA)

N71-17889*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPLORATORY STUDIES ON MODIFIED ALUMINIDE COATINGS FOR LOW CARBON AND STAINLESS STEELS

Ernest W. Klechka and Salvatore J. Grisaffe Washington Mar. 1971 22 p refs
(NASA-TM-X-2201; E-5995) Avail: NTIS CSCL 11F

Five modified aluminide coatings were applied to 304 stainless steel and low carbon steel. The coated specimens were cyclically furnace oxidation tested for up to 100 hours at 2000 F and 600 hours at 1800 F. The coatings were evaluated based on visual appearance after oxidation, metallographic examination, and X-ray diffraction analyses. Following furnace oxidation tests, a Ni-Cr-Al coating on 304 stainless steel was selected for further study in an automotive thermal reactor test. The results of this testing thus far (166 cycles), show good oxidation resistance in an automotive exhaust environment. Author

N71-17894# WADCO Corp., Richland, Wash.

CREEP RATE CORRELATION IN SOLUTION-TREATED TYPE 304 AND 316 STAINLESS STEELS

J. F. Bates, E. R. Gilbert, and A. J. Lovell Oct. 1970 12 p refs
(Contract AT(45-1)-2170)
(WHAN-FR-25) Avail: NTIS

Creep rate data on annealed AISI types 304 and 316 stainless steel were analyzed. Empirical equations which relate the minimum creep rate, testing stress, and testing temperature are described. Temperatures and stresses vary from 900 to 1700 F and 1.5 to 58 psi for the 304 data, and from 1000 to 1400 F and 10 to 63 ksi for the 316 data. Author

N71-17910# Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering.

HIGH TEMPERATURE OXIDATION OF COLUMBIUM AND Cb-10 AT. W. ALLOY

V. K. Sikka and C. J. Rosa Sep. 1970 110 p refs
(Contract DAHC04-69-C-0016; Proj. Themis)
(AD-715007; Themis-70-14) Avail: NTIS CSCL 11/6

Oxidation kinetics of Cb and Cb-10 at.%W alloy over the temperature 900-1200C, and oxygen pressures of 100-760 torr were determined using highly sensitive Cahn Electrobalance. The products of oxidation were examined metallographically and by x-ray diffraction methods. Author (GRA)

N71-17911# Army Foreign Science and Technology Center, Washington, D.C.

OPTICAL PROPERTIES OF REAL METALLIC FILMS AND MICROTHEORY [OPTICHESKIYE SVOYSTVA REALNYKH METALLICHESKIKH POKRYTIY I MIKROTFORII]

G. V. Rozenberg 21 Oct. 1970 77 p Transl. into ENGLISH from the book "Optika Tonkosloinikh Pokrytii" USSR, Fizmatgiz Press, 1958 p 268 - 354
(AD-715296; FSTC-HT-23-1187-70) Avail: NTIS CSCL 11/6

The optical properties of real metallic films are characterized and simulated by their energetic coefficients of reflection, transparency and absorption, as well as by phase shifts during reflection and passage of light through the films. The experimental data are used as the foundation of a presentation that permits examination of the effective constants of a film and, in connection with these, microtheories that have been advanced to explain the optical properties of real metallic films. Author (GRA)

N71-17912# Rhode Island Univ., Kingston. Dept. of Physics.

ULTRASONIC MEASUREMENT IN LIQUID ALKALI METALS. PART 1: ULTRASONIC VELOCITY AND ABSORPTION IN LIQUID MIXTURES OF K-RB AND NA-CS, PART 2 Final Report

M. G. Kim, K. A. Kemp, and S. V. Letcher 20 Nov. 1970 59 p refs
(Contract Nonr-396(15))
(AD-714866) Avail: NTIS CSCL 11/6

Ultrasonic absorption and velocity measurements have been made in high purity liquid sodium, potassium, rubidium, and cesium at temperatures from their melting points to 250C. Corresponding classical absorption values have also been computed over these ranges of temperature. It has been found that the measured absorption values exceed the classical values by 3% to 30%. These excess absorptions are attributed to structural relaxation. The ratio of bulk viscosity to shear viscosity was found to be approximately 2.3 in sodium and potassium, 3.4 in rubidium and 4 in cesium. Sound velocities are presented as linear functions of temperature. Both observed and classical absorptions are given as quadratic functions of temperature. Ultrasonic absorption and velocity measurements have been made in potassium-rubidium and sodium-cesium alloys at temperatures from 25C (or the liquidus point) to 250C. It has been found that the potassium-rubidium system behaves as an ideal liquid mixture. The ultrasonic measurements in sodium-cesium system suggest a substantial molecular association peak at 75 atomic percent sodium concentration is attributed to a molecular association of the form of $3Na + Cs = Na_3Cs$. Author (GRA)

N71-17937# Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering.

DETERMINATION OF OXYGEN DIFFUSION COEFFICIENTS IN TUNGSTEN OXIDE

V. K. Sikka and C. J. Rosa Aug. 1970 54 p refs
(Contract DAHC04-69-C-0016; Proj. Themis)
(AD-715006; THEMIS-70-13; AROD-T-4-22-E) Avail: NTIS CSCL 7/4

Interruption Kinetic Technique experiments carried out on tungsten oxide films formed on tungsten yield the expression for the diffusion coefficient of oxygen anion vacancies for the temperature range 568 - 908 C. Calculations are made for the concentration of oxygen vacancies, for their free energy of formation and for ionic conductivity in tungsten oxide. Deviations from stoichiometry in the oxide are plotted against temperature on the available W-O phase diagram. Author (GRA)

N71-17938# McGill Univ., Montreal (Quebec). Dept. of Chemistry.

THE DYNAMIC VISCOELASTIC PROPERTIES OF SOME NONCRYSTALLINE METALS

Adi Eisenberg and Shimon Reich 1 Oct. 1970 16 p refs
(Contract N00014-68-C-0237)
(AD-715084; TR-24) Avail: NTIS CSCL 11/6

The viscoelastic properties of non-crystalline metals of several compositions were studied. It was found that all samples exhibited a tan delta peak at the glass transition temperature. Pd80Si(20) samples exhibited at least one sub T(g) transition, although the reproducibility was poor, while Pd80Si9Au11, in which the reproducibility was very much better, showed a very flat tan delta curve. The intensity of the glass transition, as measured either by the height of the tan delta peak or by the drop in E is very much lower than in organic materials. Author (GRA)

N71-18027# Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.

MARTENSITIC TRANSFORMATIONS IN FERROUS AND NON-FERROUS SYSTEMS: SOME HEURISTIC COMPARISONS

David S. Lieberman 1970 24 p refs Presented at the 6th Intern. Conf. on Metal Spraying, Paris
(Contract AT(11-1)-1198)
(COO-1198-753; CONF-700923-1) Avail: NTIS

Studies of crystal geometry, morphology, and kinetics in nonferrous systems contribute to the understanding of the behavior in steels. Three examples are described briefly: (1) the Wechsler-Lieberman-Read phenomenological theory, developed to describe the transitions in InTl and AuCd and applied with success to the (259) martensite transformation in Fe-Ni-C; (2) the apparent difference in habit plane orientation between insulating and semiconducting BaTiO3 and KTN, and the reason that the latter is rather precisely described by the W-L-R theory while the former does not seem to be; and (3) the eigenthermal transformation in AuCd, which suggests that the terms isothermal or athermal applied to transformations in steels may really only describe the particular conditions under which the transition was observed and not the true nature of the transformation. Author

N71-18028# Bettis Atomic Power Lab., Pittsburgh, Pa.

EFFECT OF HNO3-HF PICKLING ON STRESS CORROSION CRACKING OF Ni-Cr-Fe ALLOY 600 IN HIGH-PURITY WATER AT 600 F

R. M. Rentler and I. H. Welinsky Oct. 1970 17 p refs
(Contract AT(11-1)-Gen-14)
(WAPD-TM-944) Avail: NTIS

Specimens were machined from three heats of mill-annealed Ni-Cr-Fe Alloy 600. Subsequently, half of the specimens were

pickled in HNO3-HF acid before stressing; the pickled and the unpickled specimens were tested in a static, stainless steel autoclave system at 660 F using a high-purity-water environment. Half of the total volume of water was boiled off to ensure complete removal of oxygen. Water chemistry was checked throughout the test to ensure that no contaminants were present. Post-test examinations revealed intergranular stress corrosion cracking in both pickled and unpickled specimens. The stress corrosion performance of Alloy 600 in high purity water can vary from heat to heat and possibly within a single heat of material. Author

N71-18030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WEAR MECHANISM OF STEEL AND IRON MATERIALS FOR GUIDE STANDS
R. N. Gogitoshvili 8 Sep. 1970 16 p refs Transl. into ENGLISH from Tr. Gruzinsk. Politekhn. Inst. (Tiflis), no. 5, 1968 p 140–150 (AD-714879; FTD-HT-23-452-70) Avail: NTIS CSCL 11/6

The physical and mechanical changes were investigated arising from friction and wear. Upper and lower specimens were prepared from cast iron GG-26. Spring steel S-85 and steel SK-45 were used for lower and upper test pieces, respectively. The lower models served to stimulate the guide stands, and the upper, the moving units. The average wear values were plotted vs. the friction tracks. From electron microphotos of the metal surfaces the plastic deformation was observed at the point of contact. This was accompanied by structural changes depending on the extent of deformation. The changes noticed were: breaking up of carbides, graphite inclusions, and fissures in the pearlite base of the metals. The depth of a strongly deformed surface is 5 mu. As result of the plastic deformation the surface hardens, on the lower test pieces slightly more than the upper ones. The wear of the metals tried is largely abrasive, the rate of abrasion depending on the size of the particles torn off. The determination of the microhardness in the adhesion spots, caused through friction and wear, is of importance. Of the metals tried, spring steel displayed the highest resistance to wear. Its use is recommended for guides in heavy boring and planing machines, coupled with guides of moving units, made of cast iron or plastic material. GRA

N71-18074# California Univ., Livermore. Lawrence Radiation Lab.
CRITICAL FLUENCE NEEDED TO DESTROY THIN METAL FILMS BY LASER DEPOSITION
C. M. Boltwood, Jr. and L. M. Richards 2 Feb. 1970 19 p refs Sponsored by AEC
(UCRL-50927) Avail: NTIS

Thin films of Ni, Ag, Pb and Al were used as targets for Q-switched, filtered, ruby laser radiation. The critical fluences needed to destroy the metal films were calculated from experimental results. Melting is postulated to play a greater role in the destruction mechanism of Ni (due to its higher surface tension at melting temperature) than in that of the other metals. It is proposed for metals in which melting is an important component of the destruction mechanism, the critical fluence will be relatively independent of the input energy's spatial distribution. Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N71-18044# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF THE INFLUENCE OF PROTON-ELECTRON IRRADIATION ON THE STRENGTH OF FIBER GLASS AND ITS COMPONENTS
A. A. Kritsuk et al [1970] 9 p refs Transl. into ENGLISH from Mekhan. Polimerov, Akad. Nauk Latv. SSR (Riga), no. 4, 1970 p 755–760
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results are presented of an experimental investigation of the effect of protons and electrons on the properties of glass threads under vacuum conditions. A method is given for investigating the strength of glass fillers and glass plastics under vacuum and irradiation conditions. An estimate is made of the efficiency of the effect of irradiation, strain rate, reduced temperature, and vacuum on the properties of glass fillers and glass plastics. The effect of penetrating radiation on a solid results in the appearance of a different kind of defects inducing changes in both the structure and properties of the solids. The irradiation of organic materials, polymers in particular, causes diverse phenomena including "cross-linking" of the molecular chains, the destruction and dissociation of macromolecules, and oxidation. Author

N71-18045# Lincoln Lab., Mass. Inst. of Tech., Lexington.
P-T-X PHASE DIAGRAMS OF THE GERMANIUM-SULFUR, GERMANIUM-SELENIUM, AND GERMANIUM-TELLURIUM SYSTEMS
S. G. Karbanov July 1970 15 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 2, Khim. (Moscow), v. 11, no. 1, 1970 p 51–55 In ENGLISH and RUSSIAN
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Three-phase equilibrium pressure in germanium-sulfur, germanium-selenium, and germanium-telluride systems was measured as a function of temperature by the quartz gage method. Germanium chalcogenides are valuable materials for the manufacture of thermoelectric and photoelectric instruments. In synthesizing compounds with a given composition, it is necessary to know the P-T-X; phase diagrams for corresponding systems. The method of measuring the optical density was used to measure the partial pressures of tellurium and germanium telluride for two-phase and three-phase equilibria in the germanium-tellurium system. Author

N71-17014# Gulf General Atomic, San Diego, Calif.
RESEARCH ON GRAPHITE Quarterly Progress Report, Period Ending 14 Aug. 1970
G. B. Engle, R. J. Price, and J. C. Bokros 13 Aug. 1970 14 p refs
(Contract AT(04-3)-167)
(GA-10268) Avail: NTIS

A series of previously irradiated graphites and a number of new isotropic materials were organized to study the effect of crystallite size, crystallite orientation, and density on dimensional and property changes. Dimensional changes from a portion of the specimens irradiated in capsule GE-H-13-17 are reported. Experiments to study the temperature-history effects on dimensional changes, the behavior of highly oriented graphites, and the changes in thermal conductivity are outlined. In these experiments both previously irradiated materials and new materials have been included. A series of experiments was initiated to study the effect of coke structure on irradiation behavior. Fine-structured isotropic cokes, heated at 2600 to 2800 C, are being emphasized in these studies. During the past three years, specimens have irradiated in the Dragon reactor to measure radioinduced creep in a number of graphites. Author (NSA)

N71-17122# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
FIBRE STRESS-CONCENTRATIONS IN AN IMPERFECT

TWO-DIMENSIONAL ELASTIC COMPOSITE
F. J. Lockett Sep. 1970 29 p refs
(NPL-Ma-88) Copyright. Avail: NTIS

An elastic composite reinforced by an infinite two-dimensional array of continuous parallel fibers in which one fiber has been broken is considered. The matrix material in the neighborhood of the break is assumed intact, and both weak and strong fiber/matrix interfaces are studied. A modified shear-lag analysis agreed with numerical results. Maximum stress-concentrations are relatively small for the intact matrix and weak fiber/matrix interface combination. Author (ESRO)

N71-17125# Lincoln Lab., Mass. Inst. of Tech., Lexington.
NEUTRAL DEFECTS IN MERCURY TELLURIDE [NEYTRALNYYE DEFEKTY V TELLURIDE RTUTI]
A. V. Vanyukov et al Jun. 1970 6 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorg. Mater. (USSR), v. 6, no. 3, 1970 p 556–558
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Study of the kinetics of annealing mercury telluride single crystals, grown by the Bridgman method in mercury vapors, leads to the conclusion that neutral defects exist in them. These defects inhibit diffusion of the mercury into the crystal and remain neutral up to approximately 350 C but are ionized at higher temperatures. Since ionization of these defects leads to an increase in acceptor concentration, apparently they are excess tellurium atoms. This type of defect is associated with change in the site of the excess tellurium in the lattice, possibly with the occurrence of Te-Te bonds. These results are in agreement with established data. E.M.C.

N71-17127# Los Alamos Scientific Lab., N.Mex.
SHORT-TERM STRENGTH, CREEP, AND DUCTILITY OF GRAPHITE AT 300 TO 3500 K
N. N. Dergunov et al Sep. 1970 5 p refs Transl. into ENGLISH from Termoproch. Mater. Konstr. Elem. (Kiev), no. 5, 1969 p 354–361 Presented at the 5th All-Union Sci.-Tech. Conf., Kiev, Dec. 1967
(LA-4482-TR) Avail: NTIS

A facility and procedure for studying the short-term tensile impact and compression strength, creep, and ductility of graphite at temperatures from 300 to 3500 K are described. Experimental data on the mechanical characteristics and changes in the creep rate and ductility of three grades of graphite in this temperature range are examined. Author (NSA)

N71-17135# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SATURATED VAPOR PRESSURE OF MERCURY TELLURIDE [DAVLENIYE NASYSHCHENNOGO PARA TELLURIDA RTUTI]
T. D. Levitskaya et al Jun. 1970 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorg. Mater. (USSR), v. 6, no. 3, 1970 p 559–560
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The saturated vapor pressure of mercury telluride was determined over compositions corresponding to the mercury and tellurium boundaries of the region of homogeneity, with a static compensation method employing a Bourdon pressure gauge. The temperature in the system was regulated and measured within 0.5 C at a vacuum of 0.0001 mm Hg, and pressure arising in the system with an increase in temperature was compensated and measured with an accuracy above 1% at pressures above 1 mm Hg. Author

N71-17136# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemistry.
CRYSTALLINE LINEAR HIGH POLYMERS Final Report, 1 Jun. 1968–1 Sep. 1970
Bernhard Wunderlich 1 Sep. 1970 6 p refs
(Grant NSF GP-8687)
Avail: Issuing Activity

The morphology of the extended chain crystals of polyethylene, polytetra fluoroethylene, and polyoxymethylene was studied and the mechanism of extended chain crystal growth of polyethylene under elevated pressure was examined. The results indicate spherulitic growth habits in polymers, and reveal crystallization mechanisms of equilibrium polymer crystals and deformation modes of polymer single crystals. R.S.

N71-17164# National Physical Lab., Teddington (England). Div. of Inorganic and Metallic Structure.
A BEND TESTING STAGE FOR THE SCANNING ELECTRON MICROSCOPE
D. R. Clarke, P. R. Breakwell, and G. D. Sims Apr. 1970 16 p refs
(NPL-IMS-11) Copyright. Avail: NTIS

The use of this device for studying fractures of composite materials is described. The bend module, when fitted to a large modular stage, can be used with existing scanning electron microscopes and is capable of bending, under increasing load or cyclic loading conditions, rectangular specimens of maximum size 44 x 4 x 1.5 mm, to a maximum strain of 1.5%. The non-catastrophic stages of deformation and failure can be followed at higher magnifications than previously possible. Author (ESRO)

N71-17203# Oak Ridge National Lab., Tenn.
PROGRAM AND ABSTRACTS OF PAPERS FOR CONFERENCE ON CONTINUUM ASPECTS OF GRAPHITE DESIGN
Nov. 1970 90 p refs Conf. held in Gatlinburg, Tenn., 9–12 Nov. 1970
(ORNL-TM-3191; Conf-701105-(Absts)) Avail: NTIS

Information on material characteristics and methods of predicting the mechanical properties of graphite under in-service conditions are presented. Information is included on material characterization, constitutive equations, structural analysis, fracture, thermal shock, and design criteria. NSA

N71-17260# Bendix Corp., Kansas City, Mo.
EFFECTS OF AMINE CATALYSTS ON THE PHYSICAL PROPERTIES OF A RIGID URETHANE FOAM SYSTEM
T. E. Neet and S. L. De Giei Sep. 1970 22 p refs
(Contract AT(29-1)-813)
(BDX-613-170) Avail: NTIS

The effects of catalyst type and concentration upon the compressive properties of a rigid urethane foam system were investigated. Formulations containing six different catalysts and various concentrations of each were tested. Standard ASTM 1-inch-cube compressive specimens were prepared from both free-rise and molded billets. All data were normalized to nominal densities, 6.5 lb/cu ft for the free-rise foam and 14.0 lb/cu ft for the molded materials, thus enabling direct comparisons of strength values. The results of the investigation support the belief that the principal function of the catalyst in high density molded urethane foams is to control the reaction of the foam constituents. Author (NSA)

N71-17360*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FABRICATION DEVELOPMENT OF LIGHTWEIGHT HONEYCOMB-SANDWICH STRUCTURES FOR EXTRATERRESTRIAL PLANETARY PROBE MISSIONS
Robert G. Nagler and Robert A. Boundy 15 Jan. 1971 33 p refs

(Contract NAS7-100)
(NASA-CR-116486; JPL-TR-32-1473) Avail: NTIS CSCL 11D

The results are presented of an extensive study of lightweight resin-fiber glass honeycomb-sandwich structures that was performed to define the fabricability and economics of RF transparent structures and to provide design data for detail analysis. As part of this study, a comparison was made with lightweight adhesive-bonded aluminum honeycomb-sandwich structures so that any penalties for RF transparency could be established. The results showed that there was little difference in strength to weight in lightweight configurations for resin-fiber glass and aluminum honeycomb-sandwich structures. Aluminum showed some advantage in stiffness to weight, but resin fiber glass was easier and less expensive to fabricate and was adaptable to a wider range of aeroshell configurations. Author

N71-17353*# IIT Research Inst., Chicago, Ill.
METAL CARBIDE-GRAPHITE COMPOSITES STUDIES Final Report
23 Oct. 1969 49 p refs
(Contract SNPC-66; IITRI Proj. G6029)
(NASA-CR-116503) Avail: NTIS CSCL 11D

Several NbC-C and TaC-C composites were hot-pressed with addition of up to 50% W at temperatures of 3000 C. The results of these experiments were compared to standard NbC-C composites fabricated at 3150 C and 3000 C. The data from these experiments revealed that the W-containing composites fabricated at 3000 C possessed superior mechanical properties when compared to NbC-C composites fabricated at temperatures of 3150 C and 3000 C. Author

N71-17391# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THERMO-CHEMICAL PROTECTION OF REFRACTORY SUPERALLOYS FOR AIRCRAFT GAS TURBINES [PROTECTION DES SUPERALLIAGES REFRACTAIRES POUR TURBINES A GAZ AERONAUTIQUES PAR VOIE THERMO-CHIMIQUE]
Philippe Galmiche *In* AGARD High Temp. Turbines Jan. 1971 12 p refs In FRENCH; ENGLISH summary (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

A first part of the paper is devoted to a survey of the corrosion problems of refractory materials for gas turbines, as they appear at present in the case of the most advanced superalloys. After recalling briefly the main protection methods of refractory superalloys now in use or under study, the second part of the paper describes the chromaluminization method that has been developed. Author

N71-17462*# Alabama Univ., Huntsville. Research Inst.
MATHEMATICAL CHARACTERIZATION OF MECHANICAL BEHAVIOR OF POROUS FRICTIONAL GRANULAR MEDIA, VOLUME 1 Final Report, 1 Jul. 1969 - 31 Oct. 1970
G. Aguirre-Ramirez 1970 121 p refs
(Contract NAS8-25102)
(NASA-CR-103022) Avail: NTIS CSCL 11D

A generally accepted practice for the analysis of the response of a soil mass under external loads is to model the soil mass as a continuum. Under this assumption the distinction between modeling of a soil mass and a strictly solid mass (such as rolled steel) as a continuum is made through the constitutive equations. The basic equations of continuum mechanics are reassessed for their applicability to model a soil mass as a continuum. For the purpose of simplicity the discussion is limited to a dry (unsaturated) soil mass. Under these conditions the effect of interaction in a water soil system need not be considered. By interpreting the mass density appearing in the local balance laws of mass, momentum, and energy of continuum mechanics as the bulk mass density, the given balance equations can be taken over unchanged into soil mechanics to locally describe the corresponding balance laws for the soil. Author

N71-17602# California Univ., Livermore. Lawrence Radiation Lab.
MULTIAXIAL STRESS STUDIES ON RIGID POLYURETHANE FOAM
Maurice Zaslawsky 21 Jul. 1970 93 p refs Prepared for Sandia Corp., Livermore, Calif.
(UCRL-50909) Avail: NTIS

Thin-walled tubes of rigid polyurethane foam, at 5 lb/cu ft and 4 lb/cu ft nominal densities, were subjected to combined stresses. A universal test machine applied the axial tensile or compressive stress; an independent pressurization system supplied the internal pressure to the specimen. Changes in diameter, length, and wall thickness were measured at room temperature and at −50 F. Failure envelopes in 2-dimensional stress space were obtained for the two densities at room temperature and for the greater density at −50 F. For the wall thickness range investigated, no effect on the failure envelope was observed. Material constants were obtained in terms of orthotropic elastic theory to describe the material in terms of structure. Author

N71-17603# California Univ., Berkeley. Lawrence Radiation Lab.
SINTERING AND FERROELECTRIC PROPERTIES OF LEAD ZIRCONATE TITANATE CERAMICS
Robert B. Atkin Sep. 1970 49 p refs
(Contract W-7405-eng-48)
(URCL-20309) Avail: NTIS

Ferroelectric properties, sintering, and grain growth kinetics are interpreted using crystal defect chemistry. Lattice vacancies are created thermally, by substituting impurities with the incorrect valence and by changing the stoichiometry. Sintering follows Coble's model: bulk diffusion of vacancies from pores to grain boundaries. Oxygen vacancies are believed to be the slowest moving species. Author

N71-17789# Southwest Research Inst., San Antonio, Tex.
THERMO-MECHANICAL BEHAVIOR OF COMPOSITES Final Scientific Report, 1 Nov. 1969 - 30 Oct. 1970
Ulric S. Lindholm 30 Oct. 1970 19 p refs
(Contract F44620-70-C-0015)
(AD-715333) Avail: NTIS CSCL 11/4

The initial objective of the work with composite materials is to characterize the deformation and failure response to applied loading. The emphasis is on large amplitude loading where inelastic effects are significant and on the effect of temperature, rate of loading, and multiaxial stress states on the inelastic response. The report summarizes the technical work completed. Author (GRA)

N71-17846# Northrop Corporate Labs., Hawthorne, Calif.
CHARACTERIZATION OF SURFACE AND GRAIN BOUNDARY LAYER OF BARIUM TITANATE Final Report
Amiya K. Goswami Nov. 1970 78 p refs
(Contract N00014-69-C-0213)
(AD-715097; NCL-70-70R) Avail: NTIS CSCL 11/2

The object of this investigation was to characterize the surface layer of ceramic particles and the grain boundary layer of ceramic materials by a few selected electrical and optical experiments, observe their unusual changes, if any, and infer from them or predict for their potential applicability in electronic and electroceramic fields. Barium titanate, which is one of the basic electro-ceramic materials, was chosen as typical for characterization Author (GRA)

N71-17867# Whittaker Corp., San Diego, Calif. Research and Development Div.

FABRICATION OF GRAPHITE TUBES (EXPLORATORY PROCESSING TECHNIQUE TO PREPARE NEW AND IMPROVED EXPERIMENTAL STRUCTURAL COMPOSITE MATERIALS IN PREDETERMINED SPECIMEN CONFIGURATIONS) Final Technical Report, Jan. 1969–Jul. 1970

Audie L. Price Wright-Patterson AFB, Ohio AFML Sep. 1970 27 p

(Contract F33615-69-C-1321)

(AD-715319; MJO-3660; AFML-TR-70-223) Avail: NTIS CSCL 13/8

A program was conducted in which a fabrication method for the production of 1-inch diameter graphite reinforced epoxy test cylinders was developed. Under the program, 198 test cylinders, featuring various unidirectional and multidirectional fiber orientations, were prepared. Problems involving the preparation of prepreg were encountered and solved. Problems with higher angle fiber orientations were partially solved and it was concluded that unidirectional fiber angles over 60 deg yielded excessive scrappage rates in cylinder production. With the exception of the high fiber angles, the Plywrap fabrication technique proved reliable and efficient and indicated potential for wider application. Author (GRA)

N71-17858# Rensselaer Polytechnic Inst., Troy, N.Y.

PHYSICAL CHEMISTRY OF THE SOLID STATE OF LINEAR HIGH POLYMERS UNDER HIGH PRESSURE Final Report, 1 Sep. 1960–31 Aug. 1970

Bernhard Wunderlich Oct. 1970 25 p refs

(Contract Nonr-591(19))

(AD-715070) Avail: NTIS CSCL 7/4

A review of crystallization of linear high polymers under high pressure is given. The research performed included crystallization of polyethylene from the melt and from solution under varying conditions of time, temperature, and pressure. The extended chain crystals, obtained were analyzed by dilatometry, calorimetry, optical and electron microscopy, differential thermal analysis, X-ray diffraction. An explanation for crystallization and melting of polymers under pressure was developed. Author (GRA)

N71-17948# Princeton Univ., N.J. Frick Chemical Lab.

CHEMORHEOLOGICAL STUDY ON NATURAL RUBBER VULCANIZATES

Yuzo Takahashi and Arthur V. Tobolsky Sep. 1970 29 p refs

(N0014-67-A-0151-0011)

(AD-715010; TR-125) Avail: NTIS CSCL 11/10

Chemical stress relaxation studies were carried out in air and in vacuum (0.001 mm Hg) on two natural rubber vulcanizates, one cured by dicumyl peroxide and one by tetramethyl thiuram disulfide. These are believed to produce carbon-carbon crosslinks and monosulfide crosslinks, respectively. Chemical stress relaxation in air showed that oxidative scission along the main chain was the major cause of stress decay for each vulcanizate. The stress decay curves for both vulcanizates were nearly the same. Chemical stress decay in vacuum for the two samples was slower than the decay in air. The network with monosulfide crosslinks showed more rapid decay in vacuum than the network with peroxide crosslinks. Analysis of the effect of crosslink density on the decay curves in vacuum indicate that the cleavage was at the network junctures for the network with monosulfide crosslinks; the cleavage was along the main chain for the network with carbon-carbon crosslinks. Author (GRA)

N71-17952*# California Univ., Los Angeles.

SINTERED DIAMOND COMPACTS USING COBALT AS A BINDER

Howard Katzman and W. F. Libby [1970] 13 p refs

(Grants NGR-05-007-003; AF-AFOSR-1255-67)

(NASA-CR-116419) Avail: NTIS CSCL 11D

Diamond powder can be successfully cemented with cobalt. At 62kb the sintering occurs over the range 1570 to 1610 C. The maximum microhardness (greater than 3000 kg/sq mm on the Knoop scale) is obtained with 20% by volume of cobalt and a diamond particle size of 1-5 microns. Author

N71-17956# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemistry.

DECOMPOSITION OF STABILIZED POLYOXYMETHYLENE UNDER ELEVATED PRESSURE

Bernhard Wunderlich and Richard C. Bopp Nov. 1970 23 p refs

(Contract Nonr-591(19))

(AD-714863; TR-19) Avail: NTIS CSCL 7/3

Polyoxymethylene, endgroup protected and copolymerized, was annealed at different temperatures under 5 kb pressure. Enhanced decomposition was found at elevated pressure. Annealing to an improved crystal structure was possible only at atmospheric pressure above 170 C. The thermodynamics and products of decomposition are discussed. Author (GRA)

N71-17960# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INFLUENCE OF BASIC PARAMETERS ON THE DYNAMIC COEFFICIENT OF FRICTION OF THERMOPLASTICS

R. Brezik 27 Aug. 1970 18 p refs Transl. into ENGLISH from Plasticke Hmoty Kavcuk (Prague), v. 10, no. 6, 1969 p 299–302

(AD-714878; FTD-HT-23-417-70) Avail: NTIS CSCL 11/9

The influence of the basic parameters (the surface temperature of the friction disk, the sliding speed, the normal force, the surface roughness of the friction disk and the sliding time during a prolonged test) on the dynamic coefficient of friction of thermoplastics (branched polyethylene, polypropylene, PVC, polyamide, polymethylmethacrylate, toughened polystyrene, polytrifluorochloroethylene and polytetrafluoroethylene) was traced on the prototype of a tribometer designed for evaluating the static and dynamic coefficients of friction. Author (GRA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N71-16969# Joint Publications Research Service, Washington, D.C.

DIFFERENTIAL GAME THEORY

21 Jan. 1971 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 195, no. 2, 1970 p 296–299 and v. 195, no. 3, 1970 p 558–563

(JPRS-52221) Avail: NTIS

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1. SYNTHESIS OF OPTIMAL CONTROLS IN A LINEAR DIFFERENTIAL GAME WITH A QUADRATIC FUNCTIONAL OF PAYMENT V. A. Yakubovich p 1–6 (See N71-16970 07-19)

2. DIFFERENTIAL GAMES WITH INCOMPLETE INFORMATION L. A. Petrosyan p 7–12 refs (See N71-16971 07-19)

3. EXTREMELY INCOHERENT SPACES WITH UNIQUE HOMOMORPHISM ON THEMSELVES A. I. Raykhberg p 13–16 refs (See N71-16972 07-19)

N71-16970# Joint Publications Research Service, Washington, D.C.
SYNTHESIS OF OPTIMAL CONTROLS IN A LINEAR DIFFERENTIAL GAME WITH A QUADRATIC FUNCTIONAL OF PAYMENT
V. A. Yakubovich *In its* Differential Game Theory 21 Jan. 1971 p 1–6 ref (See N71-16969 07-19)
Avail: NTIS

A sufficient condition for the existence of optimal controls for each of two players is established, and an algorithm for the construction of the controls is presented. Author

N71-16971# Joint Publications Research Service, Washington, D.C.
DIFFERENTIAL GAMES WITH INCOMPLETE INFORMATION
L. A. Petrosyan *In its* Differential Game Theory 21 Jan. 1971 p 7–12 refs (See N71-16969 07-19)
Avail: NTIS

A discrete game model with informational lag is developed and it is proved that each mixed strategy has a strategy of behavior equivalent to it. Limiting conditions are defined, and an example of a game with lag is given. N.E.N.

N71-16972# Joint Publications Research Service, Washington, D.C.
EXTREMELY INCOHERENT SPACES WITH UNIQUE HOMOMORPHISM ON THEMSELVES
A. I. Raykhberg *In its* Differential Game Theory 21 Jan. 1971 p 13–16 refs (See N71-16969 07-19)
Avail: NTIS

Theorems are given which prove that an extremely incoherent bicompact of pi-weight is heterogeneous and that an extremely incoherent space Y with unique homomorphism on itself can be selected so that /Y/ equals an arbitrary infinite cardinal. N.E.N.

N71-17001# Institut Fiziki Vysokikh Energii, Sepukov (USSR).
REPRESENTATIONS OF THE GROUP OF COMPLEX MATRICES L(n,C) [PREDSTAVLENIYN GRUPPY KOMPLEKSNYKH MATRITS L(n,C)]
A. N. Leznov, V. Savelev, and N. A. Fedoseev 1969 16 p refs In RUSSIAN
(IFVE-STF-69-91) Avail: AEC Depository Libraries

An explicit form of the matrix elements of arbitrary transformations and the characters of irreducible representations of group L(n,C) were obtained, using transition to the limit representation. The application of the method, based on the explicit definition of bilinear invariant Hermitian form, allows one to describe all the series of unitary representations. The connection of the method of limit representation and method, based on the induced representations is clarified. Author (NSA)

N71-17028# Atomic Energy Commission Research Establishment, Riso (Denmark). Reactor Physics Dept.
INTEGRAL TRANSPORT THEORY IN VARIOUS GEOMETRIES
H. Neltrup Aug. 1970 16 p refs
(RISO-M-1289) Avail: AEC Depository Libraries

The main equation of integral transport theory in multigroup version is discussed. The calculation of the collision matrix in annular symmetric clusters by numerical integration in a modified CLUCOP scheme is described. An approximate method for obtaining the same results is given and results from this method and the original CLUCOP-programme are compared. The construction of source terms and transport corrected cross sections is also discussed. Author (NSA)

N71-17065# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
MEASUREMENT TECHNIQUES USING A PSEUDO RANDOM BINARY SEQUENCE AND FOURIER TRANSFORMATION FOR DETERMINING A SYSTEM'S TRANSFER FUNCTION
C. B. Lawrence and A. Pearson Apr. 1970 47 p refs
(AECL-3601) Avail: AEC Depository Libraries; Atomic Energy of Can. Ltd., Chalk River: $1.50

A method for measuring the transfer function of systems associated with power reactors is described. The method lends itself to doing the measurements on-line with as little disturbance as possible to an operating system. The techniques for obtaining a good signal to noise ratio when noise is unavoidable are presented. The care that must be taken with filtering and timing to ensure good results is discussed. Author (NSA)

N71-17128# Utrecht State Univ. (Netherlands).
SOME APPLICATIONS AND EXTENSIONS OF THE WIGNER REPRESENTATION IN QUANTUM STATISTICAL MECHANICS
Gerard Nienhuis (Ph.D. Thesis) Sep. 1970 128 p refs Sponsored in part by Neth. Organ. for Pure Sci. Res. (ZWO)
Avail: NTIS

The application of the Wigner representation for operators in classical statistical mechanics is shown to make quantum mechanical corrections possible. This theory is applied to corrections of the equations of state of a system with particle interactions (molecular gases), and extended to systems with rotator molecules and Brownian heavy particles. ESRO

N71-17204# Bhabha Atomic Research Centre, Bombay (India).
PARTIAL DIFFERENTIAL OPERATOR AND ITS APPLICATIONS
M. S. Trasi 1970 25 p refs
(BARC-492) Avail: AEC Depository Libraries

The properties of the partial differential operator and its inverse are examined, and it is shown how they can be used in the integration of inhomogeneous first order partial differential equations. The analogy with the total differential operator is pointed out, and a geometrical interpretation is given. It is also shown that the boundary condition has to satisfy a certain consistency condition. As an application the theory is applied to the solution of a heat convection problem in a circulating fuel reactor. The theory is first developed for the two-variable operator, then extended to the case of the three variable operator and finally to the case of the n-variable operator. Author (NSA)

N71-17206# Syracuse Univ., N.Y. Dept. of Physics.
CONTINUOUS REPRESENTATIONS AND THE KERNEL FUNCTION
Jagannathan Gomatam and C. W. Gardiner Jul. 1970 18 p refs Supported by AEC and NSF
(SU-1206-227; NYO-3399-227) Avail: NTIS

The results are presented of an investigation to demonstrate: (1) how the theory of kernel functions defined on a finite domain D can be utilized in the construction of new continuous representations; (2) the use of conformal mapping in conjunction with the Riemann mapping theorem to obtain continuous representations with respect to any finite, simply connected, schlicht domain having more than one boundary point; and (3) the explicit delineation of a method of construction of orthonormal polynomials with respect to a class of weight functions for both finite domains and infinite planes. Author

N71-17337*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN 4 SUBROUTINES FOR COUPLING

COEFFICIENTS AND MATRIX ELEMENTS IN THE QUANTUM MECHANICAL THEORY OF ANGULAR MOMENTUM

William F. Ford and Richard C. Braley Washington Feb. 1971 24 p refs

(NASA-TN-D-6173; E-6012) Avail: NTIS CSCL 12A

Subroutines written in FORTRAN 4 are presented for calculating Clebsch-Gordan coefficients, Racah coefficients, 9-j coefficients, reduced rotation matrix elements, and other related quantities. Considerable attention is paid to matters of speed and accuracy, and the coding is designed to resemble the corresponding mathematical equations as closely as possible. Author

N71-17338*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

FORTRAN PROGRAM FOR COMPUTATION OF GROUP TABLE-ALPHANUMERIC DISPLAY

Gabriel Allen and David D. Evans Washington Feb. 1971 27 p refs

(NASA-TM-X-2172; E-5927) Avail: NTIS CSCL 12A

An existing FORTRAN program for computation of group tables has been modified to allow the output to be displayed as symbols. The procedure for using the program is as follows: An isomorphism is found between the group of interest G and some subgroup T sub j of the symmetric group S sub n. The elements of T sub j are entered as input data in cycle notation. The symbols for the elements of G as they are to appear in the table are also read in. The group multiplication table for those elements of G entered is computed and printed using these symbols. Author

N71-17408*# Brown Univ., Providence, R.I. Center for Dynamical Systems.

THEORY OF A GENERAL CLASS OF DISSIPATIVE PROCESSES

J. K. Hale, J. P. La Salle, and Marshall Slemrod [1970] 27 p refs

(Grant NGL-40-002-015; Contract DA-31-124-ARO(D)-270; Grant AF-AFOSR-0693-67)

(NASA-CR-116511) Avail: NTIS CSCL 12A

A general theory of dissipative periodic systems is developed. The iterates of the period map T associated with a class dissipative periodic processes are studied, the large iterates of T are found always to have fixed points, and the existence and stability of the maximal compact invariant set of T are characterized and proved. Some indication is given of how the theory relates to retarded functional differential equations, neutral functional differential equations, and partial differential equations. Author

N71-17427*# Brown Univ., Providence, R.I. Center for Dynamical Systems.

NECESSARY CONDITIONS FOR CONTINUOUS PARAMETER STOCHASTIC OPTIMIZATION PROBLEMS

H. J. Kushner [1970] 33 p refs

(Grants NGL-40-002-015; AF-AFOSR-0693-67; NSF GK-2788)

(NASA-CR-116512) Avail: NTIS CSCL 12A

A stochastic maximum principle is obtained using abstract variational theory based on a locally convex topological space. Linearized equations are discussed, and a convex cone is derived. The open loop case is developed and then extended for closed loop systems. N.E.N.

N71-17428*# Bellcomm, Inc., Washington, D.C.

FITTING A MASS DISTRIBUTION TO A POTENTIAL

S. L. Levie, Jr. 1 Feb. 1971 23 p refs

(Contract NASw-417)

(NASA-CR-116505; B71-02002) Avail: NTIS CSCL 12A

For a fixed mass distribution, an integral criterion was previously presented for determining the set of mass values which will render the gravitational potential of the distribution a best match to a given potential over a fixed region of space. The criterion is here extended to include arbitrary bodies in the mass distribution and then is reformulated as a classical least squares matrix problem. The new formulation permits convenient calculation of the mass values, allowing one to determine an optimum mass distribution iteratively. Analytical evaluation of the weight matrix in the new formulation is performed for a case of general interest. Author

N71-17790*# Rice Univ., Houston, Tex. Dept. of Mechanical and Aerospace Engineering and Materials Science.

MODIFIED QUASILINEARIZATION METHOD FOR SOLVING NONLINEAR, TWO-POINT BOUNDARY-VALUE PROBLEMS

A. Miele and R. R. Iyer 1970 41 p refs

(Grants NGR-44-006-089; NSF GP-18522)

(NASA-CR-116198; AAR-79) Avail: NTIS CSCL 12A

Several numerical examples are presented, illustrating the simplicity and rapidity of convergence of the modified quasilinearization algorithm and the importance of stepwise control. Author

N71-17827# Texas Univ., Austin. Center for Numerical Analysis.

ON THE DETERMINATION OF THE OPTIMUM RELAXATION FACTOR FOR THE SOR METHOD WHEN THE EIGENVALUES OF THE JACOBI METHOD ARE COMPLEX

Interim Technical Report

David M. Young and Harold D. Eidson Sep. 1970 73 p refs

(Grant DA-ARO(D)-31-124-G1050)

(AD-715001; AROD-3772-61-M) Avail: NTIS CSCL 12/1

Let A be a real consistently ordered matrix with non-vanishing diagonal elements. The eigenvalues lambda of the matrix L sub omega corresponding to the successive over-relaxation method are related to the eigenvalues mu of the matrix B corresponding to the Jacobi method by Lambda + omega mu(squared root of Lambda). If the eigenvalues of B are real, then the optimum value of the relaxation factor omega in the sense of minimizing the spectral radius S(L sub omega) of omega is given by omega sub b = 2/(1+ the squared root of (1-mu bar squared)) where mu bar = S(B). The object of the present paper is to describe a method and a computer program based on this method for determining the optimum value of omega corresponding to a finite set of (complex) values of mu. Author (GRA)

N71-18006*# Arizona Univ., Tucson. Engineering Experiment Station.

THE CONTROL OF NONLINEAR STOCHASTIC CONTROL SYSTEMS UNDER DISCOUNTED PERFORMANCE CRITERIA

Cliff Andrew Harris and Theodore L. Williams Aug. 1970 138 p refs

(Grant NGL-03-002-006)

(NASA-CR-116417) Avail: NTIS CSCL 12A

The optimal control of discrete time nonlinear stochastic control systems under discounted performance criteria is considered. The dynamic equations, noise statistics, and stage cost are all time invariant. The discounted performance criteria apply when the present cost is weighted more heavily than future costs. Investigated are systems whose state is defined on the continuum. A grid is imposed on the state space, creating a finite state space which is very large. A numerical algorithm tailored to attack this problem is developed. The state space is partitioned into blocks, and the stationary cost function over each block is approximated with a quadratic surface. The algorithm then employs the dynamic programming functional equation iteratively to converge to the optimum control and cost functions. Author

N71-18009# Grumman Aerospace Corp., Bethpage, N.Y. Aerodynamics Section.

ON CRITERIA FOR CLOSED-LOOP SENSITIVITY REDUCTION
E. Kreindler and A. Jameson Feb. 1971 19 p refs Submitted for publication
(RE-403J) Avail: NTIS

Let delta x(t) be a first-order variation of a system's trajectory x(t) due to a first-order variation delta mu (t) of a system's parameter mu. A sufficient condition is derived for a nonlinear closed loop system to be less sensitive than the nominally equivalent open-loop system, according to a particular integral-square measure of delta x(t). It is shown that for this sufficient condition to be satisfied the weighting matrix must be of a specific form; this form is also shown to be necessary when one considers the closed-loop sensitivity reduction of arbitrary members of broad classes of linear and nonlinear as well as of optimal systems. Author

N71-18120# Indiana Univ., Bloomington. Dept. of Physics.
FREDHOLM METHODS IN THE THREE-BODY PROBLEM
Roger G. Newton [1970] 50 p refs Sponsored in parts by NSF and AROD
Avail: Issuing Activity

It is shown that for three particles interacting via potentials that are bounded and decrease, the Green's function of the Schroedinger equation at physical energies can be calculated by the classical Fredholm methods for L squared kernels. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N71-16919# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 244 Jan. 1971 p 4–18 refs (See N71-16917 07-30)
Avail: NTIS

Selected articles are presented on the following topics: determining velocity of vertical movements in rain by radar, the use of influence functions in weather forecasting, estimating tsunami energy during Anapa earthquake, model of accumulation and redistribution of atmospheric thermal energy, spatial correlation of annual river runoff in Asiatic USSR, determining cloud parameters by laser ranging, method for computing spectral absorption of IR radiation by gases, electrification of an isolated spherical drop, seeding of convective clouds with solid carbon dioxide, scattering clouds in mountainous regions, precursors of solar flares in the ozonosphere, atmospheric ozone during annular solar eclipse, Brownian motion of aerosol particles, induced radioactivity of ground-level air, moisture-generating capacity of airmass stratiform clouds, comparing satellite and ground cloud observations, rain formation in convective clouds, computing total brightness of the daytime cloudless sky, temperature fluctuations in the boundary layer, and radar characteristics of thawing hailstones. R.B.

N71-16923# Lockheed Missiles and Space Co., Palo Alto, Calif.
AEROSOL SCATTERING IN THE NEAR-EARTH LAYER OF ATMOSPHERE
K. P. Kutsenogii [1970] 8 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 4, 1970 p 180–185
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The diffusion of aerosols in the atmosphere near the earth's surface is computed by a semi-empirical equation and statistical analysis method. The scattering of the impurities is considered to be a function of the meteorological conditions, physical characteristics of the impurities, and the conditions of its introduction into the atmosphere. It is shown that particles less than ten microns in diameter are practically weightless, and the distance for the flux of a weightless impurity from an earthbound source is graphed. F.O.S.

N71-16924# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CORRELATION OF TRANSVERSE BEAM DISPLACEMENT IN A TURBULENT ATMOSPHERE [KORRELYATSIYA POPERECHNYKH SMESHCHENIY LUCHEY V TURBULENTNOY ATMOSFERE]
A. I. Kon et al Lexington, Mass. Lincoln Lab., MIT Mar. 1970 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gorkiy), v. 12, no. 2, 1969 p 173–180 Prepared for Lincoln Lab., MIT
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The statistical characteristics of transverse beam displacements in a turbulent atmosphere with arbitrary values of the wave parameter are computed. For a real model of turbulence, the mean square of transverse beam displacements (including those in nonuniform directions) and the correlations of displacements of parallel beams are calculated. Formulas are derived in geometro-optical approximation which relate the correlated and structural displacement functions of converging beams with the corresponding formulas for parallel beams. Author

N71-16957# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 242 15 Dec. 1970 p 3–12 refs (See N71-16955 07-30)
Avail: NTIS

News items and research reports on the following topics are summarized: site selection for Northern Hemisphere aerological stations, a method for atmospheric modification, optimum atmospheric transparency window selection for temperature measurements from satellites, fog characteristics, aersol particle size distribution stability, microphysical properties of atmospheric aerosols, spectral albedo of grass and snow, IR radiation absorption by water vapor, cloud droplet growth, the initial condensation stage in clouds, macroturbulence in the free atmosphere, glaze-rime deposits in the lower 300-m atmospheric layer, atmospheric ozone instrumentation, and the intensity and position of the Aleutian low. E.C.

N71-16962# Lincoln Lab., Mass. Inst. of Tech., Lexington.
METHODS OF UTILIZATION AND RESULTS OF TESTING THE NUMERICAL RADAR PARAMETERS OF THUNDER CLOUDS [METODIKA ISPOLZOVANIYA I REZULTATY PROVERKI CHISLENNOGO RADIOLOKATSIONNOGO KRITERIYA GROZDOPASNYKH OBLAKOV]
S. B. Gashina et al May 1970 10 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 231, 1968 p 24–28 ((D-2)-70-02) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

In previous works, numerical radar parameters were derived which permit localizing such phenomena as thunderstorms, showers, and steady precipitation in the cloud field. The confidence intervals of the vertical distribution of radio echo intensity, Y, were calculated on the assumption of a normal distribution law, permitting the observable phenomena to be distinguished with a given degree of confidence into thunderstorms, showers, and steady precipitation. The probability of the appearance of thunderstorms and showers for different values of Y is computed, using the data on the

recurrence cycle of the values Hmax, log Z1, and log Z2 in these phenomena, which are valid for the central and northwestern regions of the Soviet Union. R.B.

N71-17077# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Apr. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX BULLETIN MENSUEL, AVRIL 1970]
1970 29 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in April 1970 are tabulated. The air pollution apparatus is briefly described. ESRO

N71-17129# European Space Vehicle Launcher Development Organization, Paris (France).
A STATISTICAL INVESTIGATION OF WIND DATA RECORDED IN FRENCH GUIANA
C. R. Vincent Dec. 1970 90 p refs
(ELDO-TN-8) Avail: NTIS

French Guiana meteorological data, 1966–70, were analyzed. The wind profiles were characterized by direction reversals with altitude, and annual changes. The south-north wind component was often negligible. Statistical parameters are given along with interlevel correlation and distribution functions. Author (ESRO)

N71-17153# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Oct. 1970 [OBSERVATIONS CLIMATOLOGIQUES BULLETIN MENSUEL, OCTOBRE 1970]
1970 17 p In FRENCH and DUTCH
Avail: NTIS

Meteorological parameters measured at different Belgian weather stations during October 1970 are given. ESRO

N71-17154# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Nov. 1970 [OBSERVATIONS CLIMATOLOGIQUES BULLETIN MENSUEL, NOVEMBRE 1970]
1970 16 p In FRENCH and DUTCH
Avail: NTIS

Meteorological parameters measured at different Belgian weather stations during November 1970 are given. ESRO

N71-17165# Hamburg Univ. (West Germany).
ON GRAVITY WAVES IN THE LOWER ATMOSPHERE [UEBER SCHWEREWELLEN IN DER UNTEREN ATMOSPHAERE]
H. Mueller 1969 89 p refs In GERMAN; ENGLISH summary *Its* Tech. Mitt. aus Inst. fuer Radio- und Maritime Meteorol. and Meteorol. Inst. No. 4
Avail: NTIS

Gravity wave propagation in two and three-layer atmospheric models is discussed. The analysis facilitates interpreting pressure and wind variations with periods from 2 to 20 minutes observed near ground. The frequency equations, from which the phase velocity is estimated, and the equations for vertical dependence of wind and pressure disturbances, are derived. ESRO

N71-17171# Joint Publications Research Service, Washington, D.C.
DETERMINATION OF CERTAIN CLOUD PARAMETERS USING A LASER RANGEFINDER
Ye. G. Shvidkovskiy et al *In its* Appl. Phys. 14 Jan. 1971 p 12–14 refs (See N71-17168 02-23)
Avail: NTIS

A method of using laser backscatter for determining cloud structure is presented. The water content distribution and drop concentration are obtained from the profile of the scattering factor, and representative oscillograms of backscattered signal from cumulus humilis and stratocumulus clouds are included. N.E.N.

N71-17186# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ON THE USE OF RADAR FOR RANGING METEOROLOGICAL TARGETS
Arnold Kawecki 28 Apr. 1970 20 p refs Transl. into ENGLISH from Prace Panstwowego Instytutu Hydrologiczno-Meteorologicznego (Poland), no. 92, 1967 p 43–50
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The conditions under which it is possible to obtain reliable radar measurements of precipitation are determined. The relation is developed between the measurement range and the vertical elevation of the beam, altitude of the 0 C isotherm, and antenna altitude over the earth's surface. The minimum required elevation of the radar beam to be used for measurements of precipitation over large territories is estimated. Author

N71-17187# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PRESENT-DAY RADAR METHODS FOR MAKING METEOROLOGICAL OBSERVATIONS OF CLOUDS AND CLOUD SYSTEMS [SOVREMENNYYE METODY RADIOLOKATSIONNYKH METEOROLOGICHESKIKH NABLYUDENIY ZA OBLAKAMI I OBLACHNYMI SISTEMAMI]
B. M. Sal'man May 1970 11 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 231, 1968 p 3–8
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Basic research in developing and implementing new operational methods for meteorological radar are briefly reviewed. The characteristics of radar equipment for investigating the echo structure of clouds and precipitation are discussed with respect to the development of the MRL-1. The radio echoes from clouds and cloud systems are studied by comparing the radar information with simultaneous data from ground-based and airborne observations. The MRL-1 methods of data acquisition, interpretation, and presentation are described. N.E.N.

N71-17421# Chicago Univ., Ill. Lab. for Atmospheric Probing.
DOPPLER WINDS, STALACTITES, AND SECONDARY GENERATORS AT THE EVAPORATION BASE OF AN ICE CRYSTAL OVERCAST
F. Ian Harris, B. Ekpenyong, David Atlas, and Robert Serafin (Ill. Inst. of Tech., Chicago) [1968] 6 p refs
(Grant NSF GA-10639)
Avail: Issuing Activity

The effects of evaporative cooling at the base of dense cirrus and altostratus clouds were discussed earlier on the basis of cloud and aircraft data. The development of 'stalactites' or mammata-form appendages at the base of such clouds was attributed to evaporative cooling. It was also proposed that secondary generators form near the cloud base and that these produce precipitation trails which move with the winds near the cloud base level, thus accounting for the motion of small precipitation areas. The given phenomena are investigated using a combination of five ultrasensitive Doppler and conventional radars. Author

N71-17478*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
THE RESPONSES OF BALLOON AND FALLING SPHERE

WIND SENSORS IN TURBULENT FLOWS
George H. Fichtl Washington Feb. 1971 32 p refs
(NASA-TN-D-7049; M-166) Avail: NTIS CSCL 04B

The responses of wind sensors in turbulent flows are analyzed using Fourier transform techniques. The linearized equations of motion of a sensor that is subject to drag and gravitational body forces are developed by perturbing a sensor about an equilibrium uniform motion with turbulent or random wind fluctuations. The wind environment and sensor velocities are decomposed with stochastic Fourier-Stieltjes integrals, and the linearized equations of motion are used to derive the response functions and phase angles of the sensor motions. The results of the analysis are used to analyze the response properties of the jimsphere balloon wind sensor and the effects that balloon motions would have on turbulence spectra if they were calculated with balloon and falling sphere wind data. Author

N71-17488# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 245 28 Jan. 1971 p 7–24 refs (See N71-17486 07-30)
Avail: NTIS

News items and research reports on the following topics are summarized: computer processing of pilot balloon observations, ultramicroscopy of cloud phase states, pneumatic nozzle for electrically charged fluid particles, radiation balance to 30 km altitude, ice particle accumulation in clouds, drop condensation growth, stratiform cloud models, latitude effect in upper level cloud development, optical system effect on attentuation, precomputing pressure fields over Pacific Ocean, cloud development in modified zones, crystallization zone expansion, sound transmission properties of ice, and Arctic effect on Soviet climate. Other reports summarized include information on: the climatology of the earth radiation balance, infrared radiation absorption by water vapor, natural radioactive products effect on ionization balance, spectral structure of radiant heat flux, solar radiation reflection, and predicting spring floods in western Siberia. E.C.

N71-17517# National Weather Service, Silver Spring, Md. Techniques Development Lab.
COMPUTER PREDICTION OF PRECIPITATION PROBABILITY FOR 108 CITIES IN THE UNITED STATES
William H. Klein Feb. 1971 36 p refs
(NOAA-TM-MWS-TDL-39) Avail: NTIS

The perfect prog method of combining numerical and statistical weather prediction is applied to develop an automated system for forecasting the probability of precipitation at 108 cities on the mainland of the United States during daytime and nighttime periods from 12 to 60 hours in advance. Multiple regression equations are derived from a 4–5 year sample of data for each city and each season of the year by screening twice-daily geographical arrays of the following predictors: initial 850-mb height, initial 850-700 mb mean dew-point spread, and previous 12-hour precipitation at the network of surface stations. The forecast system is applied in an iterative fashion in 12-hour time steps by using as input numerical predictions of height and moisture at standard grid points as well as prior values of precipitation. The resulting computerized forecasts of precipitation probability, when applied on an operational basis in real time, offer valuable guidance to the local weather forecaster. Author

N71-17518# National Weather Service, Silver Spring, Md. Techniques Development Lab.
PREDICTION OF SURFACE DEW POINT TEMPERATURES
R. C. Elvander (M.S. Thesis – N.Y. Univ.) Feb. 1971 44 p refs
(NOAA-TM-NWS-TDL-37) Avail: NTIS

Screening regression is used to obtain relationships between predictands consisting of surface dew point temperatures, and predictors consisting of the predictand values a day earlier and upper air parameters analyzed at selected gridpoints on the same day. The dependent data are stratified by bimonthly periods, July-August and November–December, and consist of 10 years of surface observations, 1951–60, taken at 1400 LST at 89 cities in the United States. The upper air predictors are obtained from twice daily values of 700- and 1000-mb heights on a diamond grid which covers most of North America and the adjacent oceans. Correlation fields illustrating the large-scale relationships between the predictors and predictands are shown. The resulting equations for November–December are used to obtain dew point temperature forecasts by applying them to numerical prognostic maps. Author

N71-17527# National Aviation Facilities Experimental Center, Atlantic City, N.J.
FIELD TEST AND EVALUATION OF THE NAS EN ROUTE STAGE A MODEL 1b WEATHER SUBSYSTEM Final Report, Feb.–Nov. 1969
Howard L. McFann Mar. 1971 122 p
(FAA-NA-70-62) Avail: NTIS

Four weather outline generators produced contours around radar weather clutter at two different intensity levels. The contours were processed by the radar video digitizers for transmission to air route traffic control centers as weather map messages. A series of technical and operational tests were run in the field to obtain performance data pertinent to the preparation of specifications for future systems. Calibration methods and trouble shooting aids were established. It was concluded that the generators were capable of producing reliable contours around the periphery of clutter without interference from aircraft signal returns. The dynamic range of the systems, when using logarithmic video inputs, was sufficient to permit contouring of weather cells from 42 to 50 db above the radar receiver minimum discernible signal levels. Effective control of weather map data rates was achieved by a sampling and interleaving technique that transmitted outer contour data every 8.4 deg and inner contour data every 2.1 deg. Author

N71-17732# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
EDITING OF RADIOSONDE ANGULAR DATA
Louis D. Duncan and Randal K. Walters Sep. 1970 31 p refs
(AD-715351; ECOM-5330) Avail: NTIS CSCL 4/2

A procedure is developed for identifying spikes in radiosonde angular data and synthesizing replacement values. The procedure is based upon the assumptions that the mean value function of the data is approximately parabolic locally and that the noise distributions of individual observations are uncorrelated and homoscedastic. A third-order difference operator is then defined which annihilates the mean value function and at the same time propagates spikes into an easily detectable pattern. Statistical tests are developed to determine significant patterns associated with spikes. The computations and tests are designed for incorporation into a digital computer processing routine. Author (GRA)

N71-17734# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
FRONTAL MOTION IN THE ATMOSPHERE
Eli L. Turkel Sep. 1970 149 p refs
(Contract N00014-67-A-0467-0016)
(AD-715068; IMM-385) Avail: NTIS CSCL 4/2

The motion of frontal disturbances in the atmosphere is studied based on several nonlinear models proposed by Stoker. In the first model, the air is considered to be an incompressible fluid moving over a plane tangent to the rotating earth. The fluid

consists of two layers and the density in each layer is assumed to be constant. The hydrostatic pressure law is then used to reduce this to a two space dimensional model. The boundary between these layers is a contact discontinuity and so instabilities may occur at this frontal surface. Author (GRA)

N71-17794# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla. Radar Meteorological Lab.
IDENTIFICATION OF DAMAGING SURFACE WINDS IN TROPICAL THUNDERSTORMS UTILIZING INCOHERENT WEATHER RADAR AND METEOROLOGICAL OBSERVATIONS Final Report, 1 Sep. 1967 – 30 Nov. 1969
Homer W. Hiser, Harry V. Senn, and Charles L. Courtright May 1970 42 p refs
(Contract F19628-67-C-0392)
(AD-715303; AFCRL-70-0542) Avail: NTIS CSCL 4/2

Radar precipitation echoes and sferics data were examined for eighty-four cases of high winds, small tornadoes, waterspouts and funnel clouds in the South Florida area to determine what radar signatures, if any, can be used to identify these storms. Two radars were used to obtain three-dimensional, intensity-contoured data on time-lapse film during the summer thunderstorm season, May through October, 1968 and 1969. This permitted many types of correlations. It was found that echoes during the afternoon hours with tops above 30-35,000 ft., reflectivity values of 1,000 to 10,000 mm to the 6th power/cubic meter, and lifespans greater than one hour are most likely to produce damaging surface winds in the South Florida area. Author (GRA)

N71-17836# Williams Coll., Williamstown, Mass.
FOURIER ANALYSIS OF WEATHER AND WAVE DATA FROM LAKE MICHIGAN
William T. Fox and Richard A. Davis, Jr. (Western Michigan Univ.) 20 Oct. 1970 52 p refs
(Contract N00014-69-C-0151)
(AD-714888; WC-2-TR-1) Avail: NTIS CSCL 4/2

Field data were collected on wave and weather parameters at Stevensville and Holland, Michigan during the summers of 1969 and 1970. Weather parameters include barometric pressure, wind speed and direction, air temperature and sky condition. On-shore and along-shore components of the wind were derived by a sine transformation of wind direction. Lake and groundwater levels were recorded from pipes placed in the beach. Wave parameters including period, height, depth, breaker angle and breaker distance were recorded at the plunge zone, in the breaker zone, and at a tower located 585 feet offshore. Measurements of the parameters were made at two hour intervals for thirty days for a total of 360 observations per variable. The observed data was analyzed on the computer by extracting the first 15 Fourier harmonics for each variable, computing the percentage of the total sum of squares accounted for by the harmonic and plotting the resultant curve. The curves are strongly influenced by a low pressure system which passed through the area on 27 and 28 July 1969. The curves for barometric pressure, wind speed and direction can be correlated with those for breaker height, breaker angle and longshore current. The curves for breaker angle and longshore current velocity closely resemble the first derivative of the curve for barometric pressure. Author (GRA)

N71-17923# Grumman Aerospace Corp., Bethpage, N.Y. Geo-Astrophysics Section.
DISPERSION MODELING OF AIRPORT POLLUTION
S. N. Milford, G. C. McCoyd, A. Aronowitz, and J. H. Scanlon Dec. 1970 22 p refs Presented at SAE/DOT Conf. on Aircraft and Environ., Washington, 8 – 11 Feb. 1971
(RE-398J) Avail: NTIS

The procedures followed in developing and validating computer models of air pollution caused by airports are described. Such dispersion models are used to calculate how the pollution emitted from the many contributing sources spreads to affect surrounding areas. This simulation permits a realistic evaluation of alternative strategies for air pollution abatement. The basic elements of a modeling problem are seen to be the emission sources, the meteorology, and the dispersion parameters; current methods for handling each of these are explained. The treatment of a sample airport is described and typical results are presented. Areas in which limited knowledge affects the implementation or accuracy of airport dispersion modeling are indicated. Author

N71-17928# Fish and Wildlife Service, Washington, D.C.
THE TRADE WIND ZONE OCEANOGRAPHY PILOT STUDY. PART 9: THE SEA-LEVEL WIND FIELD AND WIND STRESS VALUES, JULY 1963 – JUNE 1965
Gunter R. Seckel Jun. 1970 68 p refs
(SR-620) Avail: Issuing Activity

Wind observations and derived wind stresses are summarized in 5 deg square units of the area lat. 0 to 35 N, long. 130 to 170 W., for each month. The results complement time-sequence oceanographic observations of the Trade Wind Zone Oceanography Pilot Study in the area 148 to 157 W, February 1964 to June 1965. The sources and processing of wind observations, and the computations to obtain the zonal and meridional components of the wind velocity, the square of the wind speed, and the zonal and meridional components of the wind stress are described. The results are consistent with monthly wind stresses computed from long-term mean winds over the North Pacific. Despite inadequacies in the distribution and quality of data, the wind and wind stress summaries are adequate for interseason and interyear comparisons. Author

N71-17929# Fish and Wildlife Service, Washington, D.C.
THE TRADE WIND ZONE OCEANOGRAPHY PILOT STUDY. PART 8: SEA-LEVEL METEOROLOGICAL PROPERTIES AND HEAT EXCHANGE PROCESSES, JULY 1963 – JUNE 1965
Gunter R. Seckel Jun. 1970 132 p refs
(SR-612) Avail: Issuing Activity

Meteorological data were summarized and large-scale heat exchange processes computed, in 5 deg square units of the area 0 to 35 N, 130 to 170 W, for each month. The results complement time-sequence oceanographic observations of the Trade Wind Zone Oceanography Pilot Study in the area 10 to 28 N, 148 to 157 W, February 1964 to June 1965. The source and processing of meteorological data, and the computation of the radiation from sun and sky, the effective back radiation, the heat of evaporation, and the conduction of sensible heat are described. The results are consistent with monthly heat exchange processes computed from long-term mean meteorological properties in the North Pacific. Despite inadequacies in the distribution and quality of data, the meteorological data summaries and the derived heat exchange processes are adequate for interseason and interyear comparisons of large-scale, sea – air interactions. Author

N71-18061# Environmental Science Services Administration, Boulder, Colo. Wave Propagation Lab.
REMOTE SENSING OF WIND PROFILES IN THE BOUNDARY LAYER
C. G. Little, V. E. Derr, R. H. Kleen, R. S. Lawrence, R. M. Lhermitte et al Jun. 1970 125 p refs Sponsored by Natl. Air Pollution Control Admin.
(ESSA-TR-ERL-168-WPL-12) Avail: SOD $1.25

The potential capabilities of remote sensing techniques for air pollution monitoring are discussed and evaluated. Doppler radar technique is reviewed as it might be utilized with acoustic, radio, and optical waves, and a hybrid system involving the spatially resonant interaction between radio waves and powerful acoustic waves is discussed. Acoustic, radio, and optical forward scatter or

line-of-sight propagation techniques are described, and the so-called crossed beam eddy correlation technique is considered for either passive or active sensing of the eddies. The relative potentials of each technique are summarized, and recommendations are given relative to the more promising concepts of Doppler acoustic echo sounding and active crossed beam correlation. Author

N71-18117# Federal Aviation Administration, Washington, D.C. Aviation Weather Systems Branch.
METEOROLOGICAL EFFECTS ON AIR TRANSPORTATION
Arthur Hitsenrod Jan. 1971 26 p refs Presented at the 51st Ann. Meeting of the Am. Meteorol. Soc., San Francisco, 21 Jan. 1971
Avail: NTIS

Data are presented on the frequency of and costs resulting from environmental restrictions on air transportation. An operational system that overcomes the restrictive conditions is described, along with specific programs of FAA and the Department of Transportation. Author

N71-18133*# Israel Program for Scientific Translations, Ltd., Jerusalem.
BALL LIGHTNING
Walther Brand Washington NASA Feb. 1971 132 p refs Transl. into ENGLISH of the book 'Der Kugelblitz' Hamburg, Verlag von Henri Grand, 1923 170 p Sponsored by NASA
(NASA-TT-F-13228; IPST-5867) Avail: NTIS CSCL 04A

A comprehensive compilation of observational data on the ball lightning phenomenon is presented. Individual sections deal with: (1) statistics, (2) descriptive features, (3) development and dissipation, (4) empirical principles of ball lightning, and (5) theoretical and experimental clarification. D.L.G.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N71-16983# Lockheed Missiles and Space Co., Palo Alto, Calif.
ERRORS IN EARTH AND MOON HORIZON SENSORS DUE TO THE INFLUENCE OF ROUGHNESS OF THE PLANET SURFACE
I. G. Ioffe [1970] 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 8, no. 4, 1970 p 603–608
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The errors in horizon sensors due to the effects of the surface roughness of a spherical planet are determined. The general analytical expressions for the distribution function of the sensor errors in determining the direction of the vertical and the distance to the center of the planet in one and two mutually perpendicular scanning planes are obtained. Limiting errors in earth and moon horizon sensors are computed for the 95th percentile of the probability level due to the influence of surface roughness. It is shown that approximating the discontinuous distribution function of the heights of a planet surface by a continuous function influences primarily the clarification of the sensor error in determining the distance to the center of the planet. Author

N71-17121# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
ANALYSIS AND SYNTHESIS OF ERROR FIELDS OF QUASI-STATIONARY NAVIGATION SATELLITES WITH AN ADDITIONAL SET OF OBSERVATIONS [UEBER DIE ANALYSE UND SYNTHESE VON FEHLERFELDERN QUASISTATIONAERER NAVIGATIONSSATELLITEN BEI UEBERSCHUESSIGEN BEOBACHTUNGEN]
Otto Weber Sep. 1970 32 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-36) Avail: NTIS; ZLDI Munich: 9,60 DM

Random errors of navigation systems, based on range measurements to 24h-satellites and an altitude measurement, are treated. If the covariance matrix of the observations is known, the coordinates and the covariance matrix of an aircraft can be determined and represented by an error pattern. Estimates for improved covariance matrices can be derived from the observation residuals. Some rules are given for the effects of an additional observation. The error fields of two navigation systems which use two and three satellites are compared. The effect of a position error of one satellite on aircraft position and on the covariance matrix estimates is discussed under special assumptions. A systematic error in a satellite position can result in misleading estimates. Author (ESRO)

N71-17166# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
THE INFLUENCE OF SENSOR AND PLATFORM ERRORS ON THE ACCURACY OF OBTAINING A DETERMINED SATELLITE ORBIT [DER EINFLUSS DER SENSOREN- UND PLATTFORMFEHLER AUF DIE GENAUIGKEIT DER ERREICHUNG EINER BESTIMMTEN SATELLITENBAHN]
N. Ott and P. Bross Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Aug. 1970 43 p ref In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss. Prepared jointly with Bodenseewerk Geraetetech. G.m.b.H., Ueberlingen
(BMBW-FB-W-70-45) Avail: NTIS; ZLDI Munich: 8,60 DM

The error budget for a specified orientation of the gyros to the flight path plane was established for the inertial navigation system depending on the thrust acceleration components. Using acceleration profiles for launching a satellite into an 8 hour orbit, weight functions were calculated and numerical data for the resulting velocity and position errors, due to the different sensor errors until burnout, are listed. Author (ESRO)

N71-17198# Joint Publications Research Service, Washington, D.C.
GYROSCOPIC AND NAVIGATIONAL INSTRUMENTS
20 Jan. 1971 28 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (USSR), no. 6, Nov.–Dec. 1970 p 72–92
(JPRS-52214) Avail: NTIS

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1. USE OF AN ENERGETICS METHOD TO ANALYZE THE STABILITY OF A CORRECTABLE GYRO Yu. M. Sokolov p 1–6 ref (See N71-17199 07-21)

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3. A GYROOPTICAL VERTICAL A. A. Babayev p 11–18 refs (See N71-17201 07-21)

4. COMBINED RATIONAL CONTROL IN THE STABILIZATION CIRCUIT OF GYROSTABILIZERS G. A. Kryzhanovskiy et al p 19–27 refs (See N71-17202 07-21)

N71-17199# Joint Publications Research Service, Washington, D.C.
USE OF AN ENERGETICS METHOD TO ANALYZE THE STABILITY OF A CORRECTABLE GYRO

Yu. M. Sokolov *In its* Gyroscopic and Navigational Instr. 20 Jan. 1971 p 1–6 ref (See N71-17198 07-21)
Avail: NTIS

The application is reviewed of the energetics (power engineering) method of evaluating the stability with consideration of not only the nutational but also the precessional motion of a gyroscope. It is demonstrated that in precessional motion of a gyroscope, the damping of the system's natural oscillations by the moments of the dry frictional forces decreases. The results of the calculation were confirmed by modelling a system of differential equations, describing the motion of a gyroscope being corrected. Author

N71-17200# Joint Publications Research Service, Washington, D.C.
RANDOM PARAMETRIC OSCILLATIONS OF A GYRO PENDULUM ON A MOVABLE PLATFORM
Yu. V. Osetinskiy *In its* Gyroscopic and Navigational Instr. 20 Jan. 1971 p 7–10 refs (See N71-17198 07-21)
Avail: NTIS

The vertical stability of a gyro pendulum rotor axis is examined for a gyro pendulum mounted on a platform under random oscillation. It is theorized that platform acceleration is a stationary random process, the mathematical expectation of which equals zero. Within the framework of correlational theory, the condition of gyro pendulum stability is derived. Author

N71-17201# Joint Publications Research Service, Washington, D.C.
A GYROOPTICAL VERTICAL
A. A. Babayev *In its* Gyroscopic and Navigational Instr. 20 Jan. 1971 p 11–18 refs (See N71-17198 07-21)
Avail: NTIS

In an instrument equipped with an optical-mechanical scanning unit along the cone's generatrix, it is suggested that the unit of a gyro stabilizer be expanded and that the scanning unit be used as an astatic gyroscope for the construction of a vertical. The principle was tested on a simulator. The kinematic system and a diagram of the experimental model are shown. Author

N71-17202# Joint Publications Research Service, Washington, D.C.
COMBINED RATIONAL CONTROL IN THE STABILIZATION CIRCUIT OF GYROSTABILIZERS
G. A. Kryzhanovskiy et al *In its* Gyroscopic and Navigational Instr. 20 Jan. 1971 p 19–27 refs (See N71-17198 07-21)
Avail: NTIS

In accordance with engineering requirements, combined control was synthesized in the stabilization circuit of a gyrostabilizer, which is optimal in the sense of various criteria in phase trajectory sectors. Author

N71-17446*# Auburn Univ., Ala. Engineering Experiment Station.
STUDY OF AN IMPROVED ATTITUDE CONTROL SYSTEM
Joseph S. Boland, III 14 Dec. 1970 77 p refs
(Contract NAS8-20104)
(NASA-CR-103026; TR-25) Avail: NTIS CSCL 17G

The investigation of an improved attitude control system for an orbiting space vehicle is presented. A steering law is developed which greatly reduces the cross-axis responses of the system. The system stability is shown not to be adversely affected. Author

N71-17448*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Space Development Dept.
MAGNETIC ATTITUDE CONTROL SYSTEM FOR HEAO Final Report
F. F. Mobley and B. E. Tossman, eds. Nov. 1970 135 p refs
(NASA Order H-65027A)
(NASA-CR-103025; S2P-2-398) Avail: NTIS CSCL 17G

A scientific satellite project named the High Energy Astronomy Observatory (HEAO) is discussed. It is conceived as a very large satellite (30 ft long by 10 ft diameter) weighing about 25,000 lbs. to be launched by a Titan III rocket into a 2000 n.mile altitude orbit. It is intended to carry large radiation detector experiments for measuring X-rays, gamma rays, and cosmic rays, and lead to mapping of sources of radiation in the celestial sphere. Control of the satellite attitude in space would be achieved in part by magnetic devices interacting with the earth's magnetic field to provide control torques. Closed loop control would be used to achieve pointing accuracies of 1 degree. The synthesis and design trade-offs inherent to a closed loop magnetic control system, the selection of a baseline control system for HEAO-A and the performance of this sytem in both experiment scan and pointing modes are reported. Author

N71-17447*# Dynamics Research Corp., Wilmington, Mass. Systems Div.
DEFINITION OF FIELD TESTS FOR SD-53 STRAPDOWN SYSTEM AND CORRECTION OF LABORATORY TEST PROGRAMS Final Report
William H. Fincke 6 Nov. 1970 17 p refs
(Contract NAS8-25971)
(NASA-CR-103029; R-1154) Avail: NTIS CSCL 17G

Field and laboratory test programs for the SD-53 strapdown inertial guidance system are discussed. Six aspects of the test program are as follows: (1) define detailed objectives of the van and aircraft tests, (2) establish a philosophy of the evaluation and an approach to fulfill the objectives, (3) define an evaluation system configuration and approximate performance requirements, (4) define possible tests to collect data required to fulfill the objectives, (5) data reduction procedures, and (6) provide an approximate estimate of the evaluation system precision. Author

N71-17747# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF STRUCTURAL SYNTHESIS OF SPATIAL MOTION CONTROL SYSTEMS FOR AN ORBITAL AIRCRAFT IN THE EARTH'S ATMOSPHERE
B. N. Petrov et al 13 Aug. 1970 23 p refs Transl. into ENGLISH from 4th Congr. Guidance and Control in Space, Intern. Federation of Autom. Control (Warsaw), 1969 p 3–18
(AD-714798; FTD-HT-23-392-70) Avail: NTIS CSCL 22/1

A theoretical analysis is given of linear multichannel control systems for vehicles orbiting in the atmosphere of the earth at supersonic velocities. A procedure is developed for obtaining a set of control system structures providing a selection invariance which can be used as a basis for the optimization of such control systems in terms of both quality and simplicity of realization. Equations describing the spatial motion of such vehicles and a graphic mathematical model of these equations are derived in the process. The methods of graph theory are applied in developing the algorithms for constructing such control systems. GRA

N71-17796# Naval Research Lab., Washington, D.C. Security Systems Branch.
AN EXTENSION OF NONSYNCHRONOUS INTERROGATION REPETITION FREQUENCY SELECTION METHODS
W. K. Gardner Nov. 1970 38 p refs
(AD-715336; NRL-MR-2175) Avail: NTIS CSCL 17/7

Consideration of the timewise occupancy within the overall period band due to initial choices of nonsynchronous Interrogation Repetition Frequencies (IRFs) for application to radar beacon systems results in the ability to determine as well the open time slots

remaining for succeeding choices. Thus all possible succeeding choices that could become members of a particular nonsynchronous IRF set can be located. A simple method has been found for progressively locating by computer all open slots (integer period values) for each next choice of a given nonsynchronous IRF set. The blocked/open slot concept further results in a detailed understanding of the effects upon the selection process of changes in the parameter n, the number of interrogations, and the parameter delta, the dead time of a transponder, and explains the great dependency upon n and delta of the total number of available nonsynchronous IRFs. Author (GRA)

N71-17820 California Univ., Los Angeles.
PRECESSION OF AN ORBITING GYROSCOPE DUE TO CURVATURE AND TORSION OF SPACE-TIME
Leonard Sidney Abrams (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-2180

Papapetrou's definition of multipoles in terms of moments of the energy-momentum tensor is shown to lead to an inconsistency for rigid spinning test particles. A new definition is proposed, and the corresponding equations of motion are derived for non-spinning and rigid spinning test particles. The equation obtained for the angular momentum of a rigid, spherically-symmetric test particle differs by an extra term from that obtained on the basis of Papapetrou's definition. An approximate expression is derived for the angle between the gyroscope's angular momentum vector and the line-of-sight from the gyro to a fixed star. This expression shows that precession rates due to second-order aberration are three to six times as large as the relativistic precession, and cannot be eliminated by averaging over an integral number of orbits. Dissert. Abstr.

N71-17821 Alabama Univ., University.
PERFORMANCE OF TWIN GYRO ATTITUDE CONTROL SYSTEM INCLUDING PASSIVE COMPENSATION AND NONLINEAR CONTROL LAW
Richard Albert Campbell (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-1372

The performance of a twin CMG attitude control system is determined for the case when the CMG is attached to the vehicle structure by a passive compensation network, consisting of a paralleled spring and a viscous damper. Also derived and evaluated is a nonlinear control law that would enable a twin CMG control system to perform large angle maneuvers at rates equivalent to those of a RCJ system and yet to maintain the attitude acquisition accuracy of a CMG system. These objectives are first investigated using analytical methods. The acquired analytical results are then verified by experimental simulation of the control systems. Dissert. Abstr.

N71-17828# Naval Intelligence Command, Alexandria, Va. Translation Div.
PULSE-PHASED RADIO NAVIGATION SYSTEM LORAN-C
V. I. Bykov et al 24 Nov. 1970 93 p refs Transl. into ENGLISH from the Russian
(AD-715255; NIC-TRANS-3139) Avail: NTIS CSCL 17/7

General conclusion of various sources from the non-Soviet literature and some practical data obtained as a result of observation of the operation of a LORAN-C during the time period 1963-1965 are presented. In operation the pulse-phased system, by comparison with other systems, utilizes a more complicated method of transmission of long radio waves and more complicated shipboard equipment is necessary for obtaining a similar reading of the navigational data. This definitely makes it difficult to study the operation of the pulse-phased system. Therefore, the present work may help master the basic operating principles of the pulse-phased system and correctly evaluate the technical and navigational possibilities of the LORAN-C radio navigation system. Author (GRA)

N71-17940# Army Foreign Science and Technology Center, Washington, D.C.
RADIO ELECTRONICS IN MARINE NAVIGATION
A. E. Potemkin 14 Oct. 1970 106 p refs Transl. into ENGLISH of the publ. ' Radioelektronika v Sudovozhdemii' Moscow, Transport Publishing House, 1967 p 1-114
(AD-714916; FSTC-HT-23-192-71) Avail: NTIS CSCL 17/7

Radio electronic equipment for marine navigation used aboard merchant ships. Discussion of radio direction finders, radar, and radio navigation systems. The book takes up the use of hydroacoustics, radio astronomy, infrared techniques, satellites used for navigational purposes, and inertial systems. Questions concerned with the automation of marine navigation are discussed. GRA

N71-18006*# ITT Aerospace/Optical Div., San Fernando, Calif. Defense Space Group.
AUTOMATIC RENDEZVOUS AND DOCKING Final Report
S. A. R. Ayyar and T. E. Flom May 1970 208 p refs
(Contract NAS8-23973)
(NASA-CR-103037) Avail: NTIS CSCL 17G

A digital computer program that simulated two earth orbiting satellites while they were performing station keeping and docking closure maneuvers has been developed. The maneuvers are to be performed automatically using the Scanning Laser Radar (SLR) system. Automatic rendezvous and docking capability depends on the use of the onboard digital computer to produce steering commands to the autopilot generated from the sensed state parameters. The main sensor is the ITT scanning laser radar which provides mutual range, range rate, angle and angle rate data to the vehicle computer. Since measurement parameters are corrupted by noise and the system state (vehicular positions and velocities) is defined by a dynamical system, a recursive filter was designed to estimate the vehicle state from the noisy measurement vector. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N71-16984# Battelle-Northwest, Richland, Wash.
USER'S MANUAL FOR NOISY 1: A PROGRAM FOR CALCULATION OF SPACE DEPENDENT SPECTRAL DENSITIES IN CUBICAL REACTORS
James R. Sheff Sep. 1970 79 p refs
(Contract AT(45-1)-1830)
(BNWL-1260) Avail: NTIS

The features of the NOISY1 program for calculation of space-dependent auto and cross spectral density functions of the noise in a nuclear reactor are described. The modular or segmented construction of NOISY1 is described and emphasized as a useful feature. SEARCH/DESTRY and SNOOPY, two auxiliary programs for cal-comp graph construction, are also described. The programs are written in FORTRAN 5 for UNIVAC 1108. Author (NSA)

N71-17002# FIAT S.p.A., Turin, Italy. Sezione Energia Nucleare.
DEVELOPMENT OF PROTOTYPE FUEL ELEMENTS FOR PRESSURIZED WATER POWER REACTORS Final Report

[SVILUPPO PROTOTIPI DI ELEMENTI DI COMBUSTIBILE PER CENTRALI NUCLEARI AD ACQUA IN PRESSIONE, RAPPORTO FINALE]

I. Amato, G. Frigerio, A. M. Moncassoli, and G. Previti 1970 110 p refs In ITALIAN
(Contract EURATOM-078-66-2-TEEI)
(EUR-4406-i) Avail: AEC Depository Libraries

The development of a fuel element with UO2 pellets clad with Zircaloy-4 is described. The supporting frame is stainless steel whereas the grids are made of Inconel. The fabrication of a prototype fuel element is described. The most interesting aspects are described of the nuclear, thermohydraulic and mechanical design of the fuel element together with the setting up of its fabrication technology. Author (NSA)

N71-17010# Argonne National Lab., Ill.
MISTRAL: THERMODYNAMIC MIXED FLOW ALGORITHM FOR ROD ASSEMBLIES (16740) [MISTRAL - THERMO - DYNAMISCHER MISCHSTROMUNGSALGORITHMUS FUR STABBUNDEL (16740)]

W. Baumann Oct. 1970 32 p refs Transl. into ENGLISH from German report KFK-988 Sponsored by AEC Prepared for Argonne Natl. Lab., by Sci. Transl. Serv., Ann Arbor, Michigan
(ANL-Trans-858; KFK-988) Avail: NTIS

A description is given of a digital computer program for the calculation of the local temperature and mass flux in the cooling channels of a fuel element consisting of 61 rods. The computer method considers that the temperature difference between the central and near the wall cooling channels was affected by expansion, heat conductivity, and cross mixing of the coolant. The method was confirmed by studies for determination of the coolant cross mixing in air-cooled rod bundles. It is shown that good agreement exists between the digitally calculated and the measured temperature profiles. The calculation method was also used for bundles with various spacers with sodium, steam, and helium as coolant. The method offers the possibility of estimating the case of skewed thermal load which is experimentally difficult to determine. Author (NSA)

N71-17017# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
INSPECTION FOR TIGHTNESS OF NUCLEAR REACTOR COMPONENTS BY HIGH SENSITIVITY METHODS

F. Ungr 1970 16 p refs
(ZJE-86) Avail: AEC Depository Libraries

The vacuum method using helium for leak testing of the reactor outlet piping is evaluated. Theoretical preparation of the test, analysis of sensitivity, testing equipment, influence of measuring system and time on the sensitivity of measurement, and the procedure of the test are described. Author (NSA)

N71-17018# United Kingdom Atomic Energy Authority, Risley (England). Safeguards Div.
PRESSURE AND ACTIVITY HISTORIES IN A VENTILATED CONTAINMENT FOR A NUCLEAR REACTOR DURING LONG-TERM HEAT ADDITION

A. R. Edwards Jul. 1970 48 p ref
(AHSB(S)R-187) Avail: AEC Depository Libraries

In reactor accidents which do not involve near instantaneous rates of energy release to the containment volume, the time scale of energy removal may be of a similar order, leading to a finely balanced dynamic situation. Equations were derived governing such situations, when applied to a vented containment concept. These equations were used to carry out a parametric survey of a sodium fire, but the results may be adapted to many other situations involving reasonably slow rates of energy addition. It is concluded that there is little reason to demand a high design pressure for a containment building, since an appropriately sized vent plant associated with a low design pressure building can give the same degree of protection. However, the choice of too low a value for the design pressure should be avoided, otherwise an investigation into local pressure wave effects would be necessary. Author (NSA)

N71-17019# Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.
NONLINEAR STABILITY ANALYSIS IN REACTOR THEORY

M. S. Trasi 1970 55 p refs
(BARC-493) Avail: AEC Depository Libraries

A review is made of the methods used in the prediction of nonlinear stability in simple reactor systems. Some preliminary concepts and theorems are introduced; the principle underlying Liapunov's first method, its applications and limitations are then explained; these are followed by a discussion on Liapunov's second method and some applications. An elementary introduction to nonlinear dynamics is included. Author (NSA)

N71-17027# Bettis Atomic Power Lab., Pittsburgh, Pa.
REVIEW OF MECHANISMS FOR SWELLING AND GAS RELEASE OF OXIDE FUEL RODS. LWBR DEVELOPMENT PROGRAM

F. A. Nichols and H. R. Warner Oct. 1970 28 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-980) Avail: NTIS

Major disagreements exist concerning the dominant mechanisms for the release of fission gases from operating ceramic fuel elements. Except for low temperatures, where relatively small amounts of gas are released, probably by recoil and knockout mechanisms, there are two principal schools of thought on operative mechanisms; the bubble migration concept and the bubble re-solution concept. Pertinent theory and data are critically reviewed and shown to indicate a strong importance of bubble migration at the higher temperatures, with re-solution effects becoming relatively more important at lower temperatures. A comprehensive view of fission-gas swelling and gas-release mechanisms covering the full temperature range and believed to be consistent with available data is developed. Author (NSA)

N71-17029# International Atomic Energy Agency, Vienna (Austria).
IAEA INTERNATIONAL WORKING GROUP ON FAST REACTORS THIRD ANNUAL MEETING

[1970] 120 p refs Conf. held at Cadarache, 18 - 20 Mar. 1970
(NP-18365; DWR-1583) Avail: AEC Depository Libraries

The national development programs on fast reactors and fuels of each of the participants at the meeting are summarized. Countries and organizations represented are listed. NSA

N71-17061# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
STUDY OF THE SHELL STRESS DISTRIBUTION IN A LOOSE KERNEL TYPE OF SPHERICAL FUEL ELEMENT FOR A PEBBLE BED REACTOR

J. F. Whatham and P. A. E. Hawker Apr. 1970 34 p refs
(AAEC/TM-535) Avail: AEC Depository Libraries

The results are given of a study of the temperature and stress distributions on the surface of a spherical fuel element consisting of a beryllium oxide shell with a detached heat-generating kernel lying eccentrically (under gravity) on the shell wall and with carbon dioxide in the clearance space. The effects of a non-uniform distribution of surface heat transfer coefficient were investigated, the distribution having axial symmetry about the common center line of kernel and shell. Eccentricity of the kernel with respect to the shell substantially increases the maximum shell stress compared with that produced by a concentric kernel. However, the loose kernel fuel element compares favourably with one having the shell

(or coat) bonded to the kernel. Nevertheless it is likely that in a pebble bed reactor the influence of other balls in contact on the variation of surface heat transfer coefficient would have an overriding effect on the shell stresses. Author (NSA)

N71-17095# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d-Etude Nucleaires.
CALCULATIONS OF THE ATTENTUATION OF NEUTRONS BY COMPLEX GEOMETRIES [CALCUL DE L'ATTENUATION DES NEUTRONS DANS DES GEOMETRIES COMPLEXES]
Jean-Claude Nimal 1969 12 p refs In FRENCH Presented at Natl. Meeting on Digital Anal., Bordeaux
(CEA-CONF-1566; CONF-690963-3) Avail: AEC Depository Libraries

From National Meeting on Digital Analysis, Bordeaux, France. Protection is necessary from the various radiations emitted from nuclear reactors. Protection from neutrons and gamma rays is assured by shielding, which is often of complex geometry. Interactions and diffusion of neutrons and gamma rays with materials obey actions and complex laws, which are characterized by numerous numerical constants. The calculation of the intensity of the radiation at various points exterior to the shielding may be made by a computer simulation, which takes the various complexities of the individual case into account. Very few particles are not stopped by the protection. This last characteristic necessitates a bias of the simulation to minimize the computer time. Author (NSA)

N71-17148# Oak Ridge National Lab., Tenn.
OAK RIDGE RESEARCH REACTOR Quarterly Report, Apr.–Jun. 1970
W. H. Tabor and S. S. Hurt, III 10 Sep. 1970 42 p refs
(ORNL-TM-3161) Avail: NTIS

The ORR operated satisfactorily throughout the quarter, with a minimum of downtime and only minor operating difficulties. The average power level for 89.9% of the time was 30.0 MW(t). Fuel utilization continued to be satisfactory, with a current average burnup of 49.4%. Shim rods containing 168 g of U-235 (rather than 154 g, as previously constructed) were introduced into the core with satisfactory results. This change should reduce fuel costs because only one alloy will be needed in the construction of all the ORR fuel elements. One tube in the all-aluminum pool heat exchanger was plugged after it was discovered to be leaking. Additional maintenance to the process systems was rather routine in nature. The inlet to the syphon-break system (equalizer line) was equipped with a strainer to prevent the entrance of foreign material which could plug the pipe. Following the installation, the system was checked and found to be operating as designed. Author (NSA)

N71-17189# Oak Ridge National Lab., Tenn.
OPTIMUM BINARY SIGNALS FOR FREQUENCY RESPONSE TESTING
M. R. Buckner (Ph.D. Thesis–Tenn. Univ., Knoxville) Nov. 1970 142 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-3198) Avail: NTIS

An algorithm for generating multifrequency binary test signals with a prescribed distribution of signal power in selected frequencies was developed. The usefulness of these signals in dynamics studies of large multicomponent systems such as nuclear reactors was evaluated. The evaluation was made by performing numerically simulated and actual system dynamics tests using multifrequency binary signals as well as other periodic deterministic test signals. Particular attention was given to the effects of system noise and nonlinearities on such measurements. Author (NSA)

N71-17190# Idaho Nuclear Corp., Idaho Falls.
SEMISCALE BLOWDOWN AND EMERGENCY CORE COOLING (ECC) PROJECT TEST REPORT: TESTS 822 AND 823
D. J. Olson and J. F. Whitbeck Oct. 1970 58 p refs
(Contract AT(10-1)-1230)
(IN-1393) Avail: NTIS

The preliminary test results of two decompression experiments (Tests 822 and 823) performed in the Semiscale Blowdown Emergency Core Cooling Project are presented. The purpose of the Semiscale Blowdown and Emergency Core Cooling Project is to provide the experimental data base required for the development and assessment of analytical models for the prediction of the thermal-hydraulic behavior occurring in a large PWR during a loss-of-coolant accident. Tests 822 and 823 were initiated by hot leg breaks of a system configuration that includes both an operating loop and a simulated core with internals. The break size in Test 822 was 30% of the pipe area (0.027 sq ft), and the break size in Test 823 was 100% (0.09 sq ft). The measurements obtained provided information on fluid conditions as a function of time including quality, velocity, and mass flow rate as well as subcooled pressure loads throughout the loop and thrust measurements on the vessel. Author (NSA)

N71-17191# Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY OF THE TECHNICAL LITERATURE OF THE METALS AND CERAMICS DIVISION FOR 1969, VOLUME 2
Meredith R. Hill, comp. Oct. 1970 69 p refs
(Contract W-7405-eng-26)
(ORNL-4270-Vol-2) Avail: NTIS

A bibliography containing 220 separate citations is presented. The citations are in order under a master chronological listing in which each entry is given in complete bibliographical form. A subject index, author index, list of theses, list of patents, ORNL numbered topical reports, and ORNL numbered technical memorandum reports are included. NSA

N71-17206# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM Quarterly Report, May–Jul. 1970
G. R. Pfiasterer and R. A. Becker, comps. Aug. 1970 70 p refs
(Contract AT(04-3)-540)
(GEAP-10010-25; QR-25) Avail: NTIS

Summaries are presented of work performed on the research and development program of the SEFOR reactor. Experimental and/or analytical work is described concerned with: (1) fuel fabrication, (2) startup testing, (3) transient tests, (4) SEFOR safety audit, (5) SEFOR support, and (6) SEFOR operation. D.L.G.

N71-17207# Idaho Nuclear Corp., Idaho Falls.
EXPERIMENTAL INVESTIGATIONS OF REACTOR SYSTEM BLOWDOWN
G. F. Brockett, H. D. Curet, and H. W. Heiselmann Sep. 1970 50 p refs
(Contract AT(10-1)-1230)
(IN-1348) Avail: NTIS

The purpose of the Semiscale Blowdown and Emergency Core Cooling Project is to obtain experimental information describing the hydraulic, thermodynamic, and mechanical behavior of a simulated reactor system during loss of coolant for use in evaluating analytical models and codes for reactor safety assessment. The need for experiments to test the analysis development, the need for experimental data to answer specific questions unique to current 1000 megawatt pressurized water reactor (PWR) designs, and the need for experimental data to answer specific questions arising in

applying LOFT results to large power reactors are analyzed. The experimental facilities, instrumentation, and measurements are described and the experimental results are presented and discussed. The subcooled behavior typifying that of the PWR systems is discussed prior to the two-phase behavior typifying the two-phase decompression phenomena of the PWR and boiling water reactor systems. Author (NSA)

N71-17208# Los Alamos Scientific Lab., N.Mex.
HEAT LOSS FROM FUEL ELEMENTS PARTIALLY IMMERSED IN WATER
R. G. Wenzel and G. P. Arnold Jun. 1970 6 p ref
(Contract W-7405-eng-36)
(LA-4473) Avail: NTIS

Fuel-plate temperatures of inductively heated simulations of the aluminum MTR-type fuel elements used in the Omega West reactor were measured as a function of power input and plate immersion depth in water. At immersions < 5 in., the primary cooling mechanism is production and superheating of steam. A much more efficient cooling mechanism, percolation, becomes dominant at immersions > 5 in. Percolation carries liquid water directly up into the cooling channels and cools so effectively that increased input power decreases plate temperature, within the range of input power (< 5.1 kW) available. Author (NSA)

N71-17213# California Univ., Livermore. Lawrence Radiation Lab.
CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER
R. V. Griffith, A. L. Anderson, and C. L. Lindeken Oct. 1970 27 p refs Presented at the 16th Ann. Bioassay and Anal. Chem. Conf., Bethesda, Md., Oct. 1970
(UCRL-72739; CONF-701009-1) Avail: NTIS

A series of four articles on the LRL Whole Body Counter which appeared in previous LRL Hazards Control Progress Reports is presented. NSA

N71-17214# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
PRESSURE-EQUALIZING CLOSURE FOR REACTOR FUEL ELEMENTS WITH LIQUID SEAL AND POROUS BODIES
F. E. Reiss and S. Dorner Mar. 1970 21 p refs In GERMAN
(KFK-1163) Avail: AEC Depository Libraries

The stable configurations of liquids in porous media are analyzed. A new concept is presented for a pressure release valve for reactor fuel elements which utilizes a wetting or a nonwetting liquid on both sides of a porous disc. The operation of this valve is discussed and its properties are compared with those of the known simple porosity-based valve and those of the pure hydrostatic valve. The new device shows some advantages over known concepts. Author (NSA)

N71-17220# Los Alamos Scientific Lab., N.Mex.
MECHANICAL PROPERTIES OF CARBIDE AND NITRIDE REACTOR FUELS
M. Tokar, A. W. Nutt, and J. A. Leary Oct. 1970 9 p refs
(Contract W-7405-eng-36)
(LA-4452) Avail: NTIS

Mechanical property evaluations of plutonium-bearing carbides and nitrides in study of fast reactor fuels are presented, along with a review of the literature on the mechanical properties of uranium and plutonium carbides and nitrides. Author (NSA)

N71-17221# Mound Lab., Miamisburg, Ohio.
COMPATIBILITY OF Pu-238 DIOXIDE WITH PLATINUM AND PLATINUM-RHODIUM ALLOYS Interim Report
J. E. Selle, J. R. McDougal, and D. R. Schaeffer 30 Jan. 1970 124 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1684) Avail: NTIS

Test periods were as long as 360 days, and most of the work was done at 900, 1000, and 1200 C. Samples were analyzed by means of metallography, microhardness measurements, X-ray diffraction, and electron microprobe analysis. A chronology of the program to date is presented along with a discussion of the various results. The effects of impurities in the fuel, the presence of molybdenum or tantalum in the system, as well as the effects of a reducing atmosphere are presented and discussed. Attempts are made to interpret the results in terms of possible mechanisms. Author (NSA)

N71-17222# Battelle-Northwest, Richland, Wash.
PCTR MEASUREMENT OF INFINITE k FOR A TUBULAR FUEL ELEMENT WITH INTEGRAL TARGET IN A WATER LATTICE
C. L. Bennett and D. R. Oden Jun. 1970 91 p refs
(Contract AT(45-1)-1830)
(BNWL-1501) Avail: NTIS

A measurement of the infinite medium neutron multiplication factor was made for a tubular fuel containing an integral target rod in a light water lattice using the Physical Constants Test Reactor (PCTR). The concentration of boron in the moderator required to poison the cell to an infinite k of unity was determined from a null reactivity measurement. The multiplication constant and neutron utilization ratios were inferred from measurements of the spatial distributions of neutron reaction rates, coupled with reactivity measurements. Considerable emphasis was placed on the various techniques used to make corrections to foil activation data. In addition to the descriptions of the experiment and results, comparisons between experiment and theory are presented. Author (NSA)

N71-17223# Oak Ridge National Lab., Tenn.
COMPILATION OF NATIONAL AND INTERNATIONAL NUCLEAR STANDARDS (EXCLUDING US ACTIVITIES), 6th EDITION, 1970
Oct. 1970 129 p refs
(Contract W-7405-eng-26)
(ORNL-NSIC-76) Avail: NTIS

Standards activities of all national organizations, technical societies and government agencies are listed. Standards activities are included for: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hungary, India, Israel, Italy, Japan, Netherlands, Norway, Pakistan, Republic of South Africa, Spain, Sweden, United Kingdom, and Yugoslavia. International organizations activities include: Bureau Veritas, European Organization for Nuclear Research, European Atomic Energy Community, Food and Agriculture Organization, Intergovernmental Maritime Consultative Organization, International Air Transport Association, International Atomic Energy Agency, International Commission on Radiation Units and Measurements, International Commission on Radiological Protection, International Electrotechnical Commission, International Labor Organization, International Organization for Standardization, Lloyd's Registers of Shipping, Organization for Economic Cooperation and Development, United Nations, World Health Organization, and World Meteorological Organization. NSA

N71-17224# Douglas United Nuclear, Inc., Richland, Wash.
SOME ASPECTS OF SYSTEM SAFETY RELATED TO NUCLEAR POWER
P. A. Crosetti 8 Oct. 1970 11 p Presented at System Safety Soc. Meeting, Seattle, 8 Oct. 1970
(DUN-SA-153; CONF-701013-1) Avail: NTIS

Environmental considerations given to the radioactive and thermal effluents from nuclear power plants are analyzed. Safety

aspects concerning the Hanford N Reactor are discussed. Requirements for power reactor engineered safeguards and protection systems are described. NSA

N71-17234# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Progress Report, Apr.–Jun. 1970
W. F. Sheely, ed. Aug. 1970 311 p refs
(Contract AT(45-1)-2170)
(BNWL-1349-2) Avail: NTIS HC$6.00/MF$0.95

Research progress is reported resulting from the following individual projects: (1) nondestructive testing, (2) ATR water loop operation and maintenance, (3) irradiation damage to reactor metals, (4) fast reactor dosimetry and damage analysis, (5) fast reactor ceramic fuels research, (6) irradiation behavior of fast reactor fuel materials, (7) fast reactor absorber materials, and (8) nuclear graphite. D.L.G.

N71-17235# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PROPERTIES OF THE Pu ESTIMATE BASED ON WEIGHTED Pu/U VALUES
K. B. Stewart and R. A. Schneider 1 Apr. 1970 32 p ref Presented at the IAEA Symp. on Prog. in Safeguards Tech., Karlsruhe, West Germany, 6–10 Jul. 1970
(BNWL-SA-3287; SM-133/55; CONF-700701-6) Avail: NTIS

The results of analytical and simulation studies of the properties of the weighted Pu/U estimate of the amount of plutonium which is inputted into a separations facility are presented. Formulas that give the relative variance of the weighted pu/U estimate in terms of the relative process and measurement variances of the batch Pu/U and uranium estimates are developed. The situation in which there is batch-to-batch compositing and that in which there is no compositing were both studied. Author (NSA)

N71-17248# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etude Nucleaires.
EXPERIMENTAL STUDY OF THE DOPPLER EFFECT OF URANIUM IN FAST AND THERMAL MULTIPLYING MEDIA [ETUDE EXPERIMENTALE DE L'EFFET DOPPLER DE L'URANIUM DANS LES MILIEUX MULTIPLICATEURS A NEUTRONS THERMIQUES ET RAPIDES]
Alain Guyader (Ph.D. Thesis–Paris Univ.) Jul. 1970 144 p refs In FRENCH
(CEA-R-4035) Avail: AEC Depository Libraries

Experiments on the Doppler effect were made in the critical MINERVE set up in which U samples heated by high frequency induction from a device located outside the reactor core were studied by oscillation techniques. In the spectrum of a natural U-fueled heavy water-moderated thermal reactor, the Doppler effect of U-238 was expressed by the variation of the effective capture integral. The beta coefficient was in good agreement with the values calculated. In the fast reactor spectra of the coupled fast-thermal critical assemblies ERMINE, measurements made over a wider temperature range showed, in particular, dilatation effects at the phase changes of metallic U. Author (NSA)

N71-17249# Argonne National Lab., Ill.
APPLICATION OF ACOUSTIC-BOILING-DETECTION TECHNIQUES TO LIQUID-METAL-COOLED REACTORS Survey and Status Report
T. T. Anderson, T. P. Mulcahey, and C. Hsu Apr. 1970 12 p refs
(Contract W-31-109-eng-38)
(ANL-7469) Avail: NTIS

Boiling in the core of liquid metal fast breeder reactors can be detected by either of two principal methods, acoustic or neutron monitoring. Literature through June 1967 concerning acoustic methods is summarized. In the acoustic monitoring method for boiling detection, either acoustic waveguides or high-temperature acoustic sensors are recommended. Author (NSA)

N71-17250# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TEN-DECADE WIDE RANGE NEUTRON MONITORING SYSTEM Final Test Report
W. K. Green Oct. 1970 272 p Sponsored by AEC
(GEAP-11094) Avail: NTIS

The design, testing, and evaluation (under actual reactor operating conditions) of a prototype counting–Campbelling wide-range thermal neutron flux measurement channel are described. The wide range neutron monitoring system was designed to monitor 10 decades of neutron flux when used with a Type NA04 fission chamber. To obtain this wide range capability, counting techniques are used for the low range, and Campbelling techniques are used for the intermediate and high ranges. A failure mode analysis and instruction manual are included as appendices. NSA

N71-17251# Atomic Energy Commission Research Establishment, Riso (Denmark).
MONTE CARLO SUPERPOSITION CALCULATIONS OF RESONANCE INTEGRALS IN A REACTOR CELL
Peter Kirkegaard Jul. 1970 56 p refs
(RISO-M-1257) Avail: AEC Depository Libraries

A description is given of a computer program, AEK P-598 MCSUP, which calculates the resonance integral for a single resonance in a square reactor lattice cell, containing a cylindrical fuel zone surrounded by a moderator zone. The fuel zone contains only one nuclide type, while the moderator may be composed by several nuclide types. Scattering interference and Doppler broadening is included. MCSUP is a Monte Carlo code based on the super-position method devised by Spanier and Gelbard. The code is well-suited for calculations on isolated fuel rods. It is written in FORTRAN 4. Author (NSA)

N71-17323*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREJUD: A COMPUTER CODE FOR THE PRELIMINARY ANALYSIS OF TWO-DIMENSIONAL PULSE HEIGHT ANALYZER DATA
Thor T. Semler Washington Feb. 1971 31 p refs
(NASA-TM-X-2181; E-5824) Avail: NTIS CSCL 09B

A computer program for the processing of two-dimensional analyzer pulse height data, which provides an automated separation of gamma counts from neutron counts, and produces data in a format suitable for input to a spectrum unfolding code, is described. A strategy for the separation of gamma and neutron counts is detailed. Data smoothing techniques and a spline interpolation technique are described. Author

N71-17325*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF CERAMIC INSULATOR SEALS AT HIGH NEUTRON AND GAMMA FLUENCE LEVELS
Robert G. Rohal, Thomas N. Tambling, and Roger L. Smith Washington Feb. 1971 15 p refs
(NASA-TM-X-2180; E-5683) Avail: NTIS CSCL 11B

An experimental program to evaluate the in-pile performance of a group of commercially available ceramic insulator seals is described. The ceramic insulator seals were irradiated to thermal

neutron fluence levels greater than 10 to the 20th power neutrons/cm squared and gamma dose rates greater than 10 to the 14th power ergs/g of H2O. During the irradiation the seals were thermally cycled several times. Neutron radiographic investigation showed that all 24 seals investigated were leaktight to reactor cooling water at 150 F (339 K) and 150 psia (103.4 N/cm squared) throughout the irradiation. Author

N71-17339# Argonne National Lab., Ill.
FUEL CYCLE TECHNOLOGY Quarterly Report, Apr.–Jun. 1970
D. S. Webster, A. A. Jonke, G. J. Bernstein, N. M. Lavitz, R. D. Pierce et al Jul. 1970 89 p refs
(Contract W-31-109-eng-38)
(ANL-7735) Avail: NTIS

Work was done in the following areas: (1) development of two conceptual designs for plants to declad 5 metric tons/day of LMFBR fuel in molten zinc, (2) construction of a fluid-bed pilot plant to continuously convert uranium plutonium nitrate (in aqueous solution) to oxides, and laboratory experiments to identify the oxide products obtained by drop-denitration of uranium nitrate and U–20% Pu nitrate solutions at 300 to 600 C, (3) evaluation of X-ray fluorescence spectrometry as an in-line analytical method for determining the Pu/U ratio of oxide fuels, and consideration of X-ray diffraction measurement of the lattice parameter of single-phase (U,Pu) oxide as an in-line method of determining the oxygen content (O/M ratio) of oxide fuels; and (4) the development of a critically favorable centrifugal contactor for the efficient handling of plutonium from LMFBR fuels in the plutonium isolation steps of a solvent-extraction process. Highlights of ANL investigations of liquid metal decladding since early 1968 are also presented. Author (NSA)

N71-17351*# General Dynamics/Ft. Worth, Tex.
NERVA IRRADIATION PROGRAM, GTR TEST 21. VOLUME 4: EFFECT OF RADIATION ON STRUCTURAL MATERIALS TESTED AT CRYOGENIC AND ELEVATED TEMPERATURES
R. H. McDaniel, N. D. King, J. E. Warwick, and J. H. Lewis Mar. 1969 395 p refs Sponsored in part by NASA
(Contract AF 29(601)-7077)
(NASA-CR-116518; FZK-351-4) Avail: NTIS HC $6.00/MF $0.95 CSCL 18E

The effects of nuclear radiation on the mechanical and metallurgical properties of several structural materials of potential use in the NERVA engine are discussed. The materials tested were of two categories: (1) cryogenic structural materials and (2) high temperature structural materials. Mechanical properties tests were performed following irradiation by a ground test reactor. Author

N71-17352*# General Dynamics/Fort Worth, Tex.
NERVA IRRADIATION PROGRAM, GTR TEST 21. VOLUME 3: THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF SELECTED NERVA MATERIALS
E. E. Palmer, J. R. Bell, R. D. Crabtree, J. B. Wattier, H. L. Springer et al 14 Nov. 1969 520 p refs Sponsored in part by NASA
(Contract AF 29(601)-7077)
(NASA-CR-116519; FZK-351-3; NJO-20) Avail: NTIS HC $6.00/MF $0.95 CSCL 18E

The effects of nuclear radiation on the thermal conductivity and electrical resistivity of selected materials for the NERVA engine are discussed. The objectives of the tests were to: (1) determine if a change in thermal conductivity occurred, (2) measure the thermal conductivity over a selected temperature range, and (3) determine if the Widemann-Franz law is applicable in predicting thermal conductivity by use of the measured electrical resistivity. Author

N71-17360# National Lead Co. of Ohio, Cincinnati.
DIRECT READING SPECTROMETRIC METHOD USING A AgCl-LiF CARRIER TO DETERMINE IMPURITIES IN NUCLEAR-GRADE U3O8 SAMPLES
C. E. Pepper, G. R. Blank, C. E. Duff, and A. J. Pardi Oct. 1970 21 p refs
(Contract AT(30-1)-1156)
(NLCO-1071) Avail: NTIS

A method employing a 2-meter Production Control Quantometer with a 10% AgCl–LiF (1:1) carrier dc-arc technique is described for determining trace impurities in nuclear-grade U3O8 samples. Included are brief descriptions of U3O8 sample preparation, electrode design, preferred electrode graphite grades, carrier development, modifications made to the standard Quantometer, the use of alternate read-out systems, and the importance of temperature and humidity control. The accumulated development results of 16 years of operation, which could be beneficial to other users of direct-reading spectrometers for carrier-distillation dc-arc work, are summarized. Author (NSA)

N71-17361# Oak Ridge National Lab., Tenn.
FABRICATION VOIDS IN ALUMINUM-BASE FUEL DISPERSIONS
M. M. Martin and W. R. Martin Oct. 1970 34 p refs
(Contract W-7405-eng-26)
(ORNL-4611) Avail: NTIS

The introduction of fabrication voids explains variations in irradiation performance of many fuel dispersions for nuclear reactors. The void content of aluminum-base dispersion-type fuel plates was investigated at all stages of manufacture. The void content of the roll-clad aluminum-base dispersions depended on: the type and concentration of the fuel compound; the aluminum cladding alloy; and the amount of cold-rolling deformation at room temperature. For a particular material combination, the first roll-bonding reduction of as little as 15% in thickness established a constant void concentration for all subsequent hot-rolling passes. This equilibrium quantity of voids was insensitive to the initial density of fuel compact and the amount of −325-mesh fuel particles in the dispersions. The final void content of the completed fuel plate showed only a secondary dependency on hot deformation and heat treatment. Author (NSA)

N71-17362# Oak Ridge National Lab., Tenn.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report, Oct. 1970
Nov. 1970 22 p
(Contract W-7405-eng-26)
(ORNL-TM-3204; PR-15) Avail: NTIS

Development work on HTGR fuel recycle is reported under the following headings: head-end reprocessing development, refabrication development, TURF equipment design and engineering, and materials irradiation. NSA

N71-17366# United Kingdom Atomic Energy Authority, London (England).
REPORT AND ACCOUNTS OF THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY FOR THE YEAR ENDING 31 MARCH 1969 TOGETHER WITH THE COMPTROLLER AND AUDITOR GENERAL'S REPORT ON THE ACCOUNTS Annual Report
23 Jul. 1969 144 p refs
(NP-18112; AR-15) Avail: AEC Depository Libraries

Finance, accounts, and contracts and the Trading Fund report are given. Also, a review is presented of production factories and the Amersham Radiochemical Centre, the reactor program, nuclear fusion and plasma physics research, applied nuclear research and development, nonnuclear research and development, scientific and technical support, health and safety, international relations, and information services. NSA

N71-17369*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRESTARTUP THAWING OF LITHIUM COOLANT IN A NUCLEAR REACTOR FOR A SPACE POWERPLANT
Paul H. Lustig Washington Feb. 1971 29 p refs
(NASA-TM-X-2177; E-5771) Avail: NTIS CSCL 18L

A calculational study was made assuming heated argon gas being pumped through an annular space between the reactor primary loop and a surrounding jacket. Pumping power requirements and time to melt as a function of radial and axial temperature differences were plotted. Heating power and energy requirements were also determined. The lithium in the reactor could be completely melted in less than 24 hours without exceeding a temperature difference of 25 R (13.9 K) radially or 30 R (16.6 K) axially or a pumping power of 1 kilowatt. An annular gap of 1/4 inch (0.635 cm) was needed and the initial reactor temperature was greater than 200 R (111 K). Constant-heat-flux and constant-inlet-temperature modes of heating were studied, the latter of which can reduce the time to melt by a factor of 4 and the energy requirement by a factor of 2.5. The heating power was 27.5 kilowatts initially for a constant-inlet-temperature mode compared to less than 1 kilowatt of pumping power. Therefore, the heating mode may be dictated by the availability of auxiliary power. Author

N71-17422*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NEUTRONIC DESIGN FOR A LITHIUM-COOLED REACTOR FOR SPACE APPLICATIONS
Charles L. Whitmarsh, Jr. Washington Feb. 1971 40 p refs
(NASA-TN-D-6169; E-5775) Avail: NTIS CSCL 21F

Performance goals were 2.17 megawatts thermal for 50,000 hours with a coolant outlet temperature of 1222 K. The reactor was fueled with enriched uranium nitride and controlled by rotation of six fueled drums. The fuel was zoned radially to reduce local power peaking and to enhance reactivity worth of the control system. Local power in the core was limited by a 1-percent creep criterion established for the fuel cladding. Total control swing was 8.51 percent Delta k/k. Power distributions, core characteristics, and accident effects are calculated. Author

N71-17463*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME CHARACTERISTICS OF A BOILING-WATER-COOLED VAPOR TRANSPORT FUEL PIN
James R. McConaghy, Jr. Washington Feb. 1971 28 p refs
(NASA-TN-D-6162; E-5675) Avail: NTIS CSCL 18K

The behavior of a boiling-water-cooled vapor transport fuel pin is studied with the aid of a computer code. Pin behavior is investigated at high power output in the region of the boiling burnout point. A comparison is made that shows that much higher power densities can be obtained from a vapor transport fuel pin than from a conventional solid fuel pin design at pin diameters above 1 centimeter. Author

N71-17500# Atomic Energy Establishment, Winfrith (England). SGHW Development Div.
ANALYSIS OF ROD DROP AND PULSED SOURCE MEASUREMENTS OF REACTIVITY IN THE WINFRITH SGHW
I. Brittain May 1970 49 p refs
(AEEW-R-640) Avail: AEC Depository Libraries

Reactivity measurements by the rod-drop and pulsed source metmods in the heavy water reactor are seriously affected by spatial harmonics. A method of calculation is described which enables the spatial harmonics to be calculated in non-uniform cores in two or three dimensions, and allows a more rigorous analysis of the experimental results than the usual point model. The method is used to analyze all the rod-drop measurements made during commissioning of the reactor and to comment on the results of pulsed source measurements. The reactivity worths of banks of ten and twelve shut-down tubes deduced from rod-drop and pulsed source experiments are in satisfactory agreement with each other and with calculated values. Author (NSA)

N71-17501# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
ODYSSEUS 6: A COMPREHENSIVE FUEL MANAGEMENT CODE FOR AGR's
A. N. Buckler Mar. 1970 37 p refs
(AEEW-R-652) Avail: AEC Depository Libraries

A highly automated scheme of fuel management calculations is described for advanced gas-cooled reactors with on-load, continuous refueling incorporating a novel power shaping calculation, by which controllers can be set to yield desired reactivity and regionwise reactor powers. The calculations are restricted to two dimensions and two neutron groups. Author (NSA)

N71-17509# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CCTL MARK 1 AND MARK 2 PROTOTYPIC FFTF SUBASSEMBLY COMPRESSION TEST DEVELOPMENT WORK
R. B. Baker and D. E. Blahnik Aug. 1970 74 p
(Contract AT(45-1)-1830)
(WHAN-FR-18) Avail: NTIS

Subassembly compression test work performed on fuel subassemblies with 217 wire-wrapped fuel pins is described. These ductless subassemblies were compressed over a 4-foot length span by flat plates on six sides, and the side wall load was measured as a function of across-the-flats dimensions. The subassemblies were compression tested to determine the springiness that exists within the subassembly when it is compressed symmetrically from a nominal duct internal size down to a region where there are no gaps between wires and fuel cladding and where the fuel pins are temporarily deformed due to bending and torsion loads. Author (NSA)

N71-17510# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
USER'S MANUAL FOR THE 1-DX-2DB-3DB-PERT-V CODE PACKAGE
R. W. Hardie and W. W. Little, Jr. Jul. 1970 83 p refs
(Contract AT(45-1)-1830)
(BNWL-1412) Avail: NTIS

The codes have been programmed to read and write standard interface files containing groups of similar data. These data files and their use by the above codes are presented. Briefly, 1DX is a one dimensional diffusion theory program designed to compute resonance shielded multi-group cross sections using data in the Russian format and collapsed-group cross sections using flux-weighting over any specified reactor zone. The 2DB and 3DB are two and three dimensional diffusion theory burnup codes containing a material shuffling scheme. The above codes also perform critically searches on time absorption, reactor composition, reactor dimensions, and buckling using either a flux or adjoint model. PERT-5 is a one and two dimensional perturbation code designed to calculate reactivity coefficient traverses, the effective delayed neutron fraction, the neutron generation time, and the inhour/sigma k conversion factor. All codes are programmed in FORTRAN-4 for a 65K core and utilize variable dimensioning. Author (NSA)

N71-17526# Oak Ridge National Lab., Tenn.
METALS AND CERAMICS DIVISION Annual Progress Report, Period Ending 30 Jun. 1970
Sigfred Peterson, comp. Oct. 1970 257 p refs

(Contract W-7405-eng-26)
(ORNL-4570) Avail: NTIS

Brief reports are presented on research on fundamental metal and ceramic programs, fast reactor technology, space power technology, general fuels and materials research, reactor development support, and related program activities. N.E.N.

N71-17528# Argonne National Lab., Ill. Applied Physics Div.
THE USE OF PLUTONIUM IN ZPR-6 AND ZPR-9 Final Safety Analysis Report
W. Y. Kato, G. K. Rusch, L. R. Dates, C. E. Till, A. Ancarani et al Feb. 1970 270 p refs
(Contract W-31-109-eng-38)
(ANL-7442) Avail: NTIS

The split-table type critical facilities, ZPR 6 and 9, are described. The modifications which were made to the reactor cells and facilities are discussed. The hazards associated with the use of up to 1400 kg of plutonium fuel in each of the facilities are analyzed. Reactor operating procedures and the principles of reactor management are discussed in detail. A discussion of a maximum credible accident and a design basis accident is presented. Author (NSA)

N71-17533# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
N-REACTOR HYBRID SIMULATION
J. D. Lodge Oct. 1970 82 p refs
(Contract AT(45-1)-1830)
(BNWL-B-8) Avail: NTIS

The simulation model of N-reactor was converted from an all-analog to a hybrid model. The secondary system is simulated on the PDP-7 digital computer, while the primary system, which includes the reactor core, primary flow and pressurizer, is modeled on the 2133 analog. All control is done with the analog controller simulator. Programming and operating procedures for the hybrid model are included. Author (NSA)

N71-17552# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS ON LMFBR CLADDINGS, STRUCTURAL, AND COMPONENT MATERIALS STUDIES Annual Report, Jul. 1969 - Jun. 1970
Donald L. Keller Jul. 1970 42 p refs
(Contract W-7405-eng-92)
(BMI-1889) Avail: NTIS

Two potential methods to inexpensively determine radiation-induced changes in mechanical properties of cladding materials were evaluated. In a program to analyze the low cycle fatigue resistance of Incoloy 800, measurements were completed at 800 C on solution annealed specimens. When only compression or both tension and compression 10 min hold times were used, the cyclic fatigue life at 1400, 1200, and 1000 F was slightly reduced. -J.A.M.

N71-17601# Battelle-Northwest, Richland, Wash.
ANALYSIS OF THE PHOENIX FUEL EXPERIMENTS
C. M. Heeb Oct. 1970 87 p refs
(Contract AT(45-1)-1830)
(BNWL-1514) Avail: NTIS

A depletion experiment on a Pu-Al-alloy fueled core in the materials testing reactor (MTR) is described. The supporting integral experiments and the installed neutronic behavior of this integral experiments and the installed neutronic behavior of this Phoenix core are described briefly. The analysis of these experiments is described in detail. It was found that increasing the absorption of the 1 eV Pu-240 resonance to agree with measured k values results in eigenvalues which are within 1% of the experimental values over a range in Pu-240 concentrations from 8% to 23%. The observed reactivity time behavior of the core shows a more abrupt loss of reactivity with time than had been calculated. A method of partitioning the computed reactivity time slope is presented which defines the contribution each burnable isotope makes to the total slope. A comparative analysis of two methods plus nuclear data is carried out using this technique to illustrate the complexities involved in burnup analysis. Author (NSA)

N71-17604# Battelle-Northwest, Richland, Wash.
SOME OBSERVATIONS ON NOBLE GAS PARTITIONING IN DYNAMIC AIR-WATER SYSTEMS
J. Mishima and L. C. Schwendiman 25 Aug. 1970 22 p refs Presented at the 11th AEC Cleaning Conf., Richland, Wash., 31 Aug. - 3 Sep. 1970 Submitted for publication
(Contract AT(45-1)-1830)
(BNWL-SA-3360; Conf-700816-5) Avail: NTIS

Radioactive noble gases produced in fission would be released from reactor fuel elements which might fail from thermal stresses in the serious overheating incidents considered as design-basis accidents. Experiments were conducted to help determine to what degree and how rapidly krypton-85 dissolved in water will disengage in a few dynamic water-air systems and from stagnant pools. Krypton-85 carried in inert krypton was dissolved in hot water contained in an aluminum vessel with a very small air space. After equilibration, the vessel was discharged in various ways and the disengagement rate noted. Rate of release from stagnant water in vessels was also measured. In quiescent shallow pools release to air varied with the surface/volume ratio and temperature regime. During a 2-hour cooling period the krypton loss ranged from 14 to 43% of that initially present. Liquid scintillation counting techniques were used to measure krypton-85 concentrations in the water phase. Methods and techniques are described. Author (NSA)

N71-17611# Douglas United Nuclear, Inc., Richland, Wash.
TESTING AND SURVEILLANCE OF HANFORD PRODUCTION REACTOR ZIRCALOY TUBES
W. K. Alexander 13 Oct. 1970 14 p
(Contract AT(45-1)-1857)
(DUN-SA-144) Avail: NTIS

A description of nondestructive tests performed on Zircaloy tubes in the K Reactors is presented. Results of the tests are analyzed. Surveillance and destructive testing programs for Zircaloy tubes in the N Reactor are described. Tests results are presented. NSA

N71-17637# Texas Technology Univ., Lubbock. Plasma Lab.
PROCEEDINGS OF THE SYMPOSIUM ON THERMONUCLEAR FUSION REACTOR DESIGN
M. Kristiansen and M. O. Hagler, eds. 1 Aug. 1970 422 p refs Conf. held at Lubbock, Tex., 2-5 Jun. 1970 sponsored by AEC and Tex. Technological Univ.
(ORO-1171-1; Conf-700814) Avail: NTIS HC$6.00/MF$0.95

Symposium papers are presented on the following: injector requirements for open ended fusion reactors; toroidal fusion reactor technology; turbulent heating in mirror machines; neutronic aspects of a DT fusion reactor; a thermal energy conversion system for a fusion reactor; mirror machines and direct conversion; fast breeder reactor technology; wall erosion by sputtering in controlled fusion devices; engineering of a fusion plant-torch complex.; observations on teaching a fusion design seminar; and thermonuclear space power system design. Abstracts for eight other symposium papers, a symposium summary, and a bibliography on fusion reactor design studies are also given. E.C.

N71-17668# Oak Ridge National Lab., Tenn. Chemical Technology Div.
CHEMICAL TECHNOLOGY DIVISION Annual Progress Report, Period Ending 31 May 1970

Oct. 1970 307 p refs
(Contract W-7405-eng-26)
(ORNL-4572; APR-14) Avail: NTIS HC$6.00/MF$0.95

Research in chemical technology is reported and includes results of the following projects: (1) spectrophotometric studies of solutions of lanthanides and actinides; (2) transuranium-element processing; (3) irradiation effects on heterogeneous systems; (4) molten-salt reactor processing; development of aqueous processes for fast reactor fuels; (5) methods for reprocessing HTGR fuels; (6) waste treatment and disposal; (7) conversion studies in the LMFBR fuel cycle; (8) separations chemistry research; (9) chemical applications of nuclear explosions; (10) sol-gel processes for the uranium fuel cycle; (11) development of the thorium fuel cycle; (12) reactor evaluation studies; and (13) biochemical technology. D.L.G.

N71-17681# Oak Ridge National Lab., Tenn.
MECHANICAL PROPERTIES OF CERAMICS BASED ON URANIUM AND PLUTONIUM
Andre Padel Jun. 1970 80 p refs Transl. into ENGLISH from French report CEA-R-3953
(ORNL-tr-2388; CEA-R-3953) Avail: NTIS

The sound velocity and the elastic constants of UC, UN, UO2, and (UC, UN) are measured at room temperature as a function of porosity and the influence of the oxygen content on the elastic constants of (U, Pu)O(2 + or − x) is determined. Young's modulus and internal friction are measured as a function of temperature between 25 C and 1300 C for UC, UN, UO2, (U(0.82) Pu(0.18))N and (U(0.80) Pu(0.20))O(2 + or − x). Author (NSA)

N71-17684# Battelle-Northwest, Richland, Wash.
ACTIVATION OF SOME UO2 POWDERS BY MILLING AND OXIDATION-REDUCTION
M. J. Barr Sep. 1970 32 p refs Prepared in cooperation with WADCO Corp.
(Contracts AT(45-1)-1830; AT(45-1)-2170)
(WHAN-FR-8) Avail: NTIS

The effect of varying the activity of some UO2 powders by various material treatments was evaluated by calcining small portions of ceramic grade normal UO2 in nitrogen and in air to 400, 600, and 800 C. Portions of 93.15% enriched UO2 powder were activated using the oxidation-reduction technique. Powder characteristics determined on as-received and activated powders included particle size distribution, O/U ratio, B. E. T. surface area, tap density, and scanning electron micrographs. Pellet characteristics obtained from sinterability specimens included green and sintered pellet theoretical density, and sintered pellet microstructure. The particle characteristics determined were evaluated against changes in density and sintered pellet microstructure. Author (NSA)

N71-17932*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHAPED THERMAL NEUTRON FLUX FILTERS FOR AN IN-PILE TEST CAPSULE
C. Hubbard Ford Washington Mar. 1971 19 p refs
(NASA-TM-X-2196; E-5756) Avail: NTIS CSCL 18M

Flux tailoring filters are necessary to achieve uniform, flat reaction rates for configurations of test capsules to be irradiated in high thermal flux test reactors. The shaping of filters has been studied by an experimental method using (alpha,n) neutron sources in water media. The design objective was to achieve acceptably flat reaction rates along the axes of the test capsules when the unperturbed flux has a steep gradient. The flat filtered reaction rates finally attained were only slightly lower than those due to the lowest thermal flux level present before the tailoring filters were introduced. Author

N71-17933*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSFER FUNCTION DETERMINATION OF THE PRIMARY LOOP OF A CONCEPTUAL NUCLEAR BRAYTON SPACE POWERPLANT
Edward J. Petrik and Arthur W. Kieffer Washington Mar. 1971 45 p refs
(NASA-TM-X-2193; E-5830) Avail: NTIS CSCL 18E

The primary loop of a conceptual nuclear Brayton space powerplant was described by a set of nonlinear differential equations. The equations were simplified and linearized. A phase variable technique was used to determine the transfer functions for small step input disturbances in each of the following: (1) reactivity, (2) lithium flow rate in primary loop, and (3) argon flow rate in power conversion loop. The time response obtained from the transfer functions for the three input disturbances agrees with the time response obtained from the original nonlinear differential equations. Author

N71-18127# Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires.
ELECTROLYTIC MACHINING PROCESS, APPLICATIONS, AND SPECIAL STUDY ON THE TREPANNING OF TEST SPECIMENS IN BUGEY TYPE FUEL ELEMENTS
Antoine Henri Bret Feb. 1970 90 p refs In FRENCH
(CEA-N-1251) Avail: AEC Depository Libraries

Principles of both electrolytic machining (ECM) and electrical discharge machining (EDM) processes are compared. The effects of ECM on the mechanical properties of metal are reviewed. This process is influenced by a number of variables which can cause loss of accuracy. Factors affecting the interelectrode gap are also discussed. The formulas used in the calculation of metal removal rate are established from the fundamental principles of electrochemistry, e.g., Ohm's law and Faraday's law. Various applications of ECM are included and illustrated. An economical study of gas turbine blades shows that ECM excels also in large scale production. The mechanical testing of adhesive metallurgical bond between the magnesium canning and the BUGEY-type uranium fuel elements of the power reactor necessitated the trepanning of test specimens by a process which does not induce thermal effects or even cracks at the interface. Author (NSA)

N71-18143# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
FISSION PRODUCTS IN A FUEL IRRADIATED UNDER VARIABLE CONDITIONS (PROGRAM PROFIS) [EVALUATION DES PRODUITS DE FISSION DANS UN COMBUSTIBLE IRRADIE DANS DES CONDITIONS VARIABLES PROGRAMME PROFIS)
Joseph Bessis and Robert Vireflesau Oct. 1970 47 p refs In FRENCH
(CEA-R-3987) Avail: AEC Depository Libraries

The computer code PROFIS was used to evaluate the fission product concentrations in a given fuel irradiated under specified conditions. It takes into account the neutron energy spectra in the fuel, fuel composition, capture effects, changes with respect to time in the reactor running power, and possible changes with respect to time in the neutron spectra and fuel composition. The calculation methods and formulas used are given. A very brief description of the program is given. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N71-17011# Lockheed Missiles and Space Co., Palo Alto, Calif.
SPEED OF SOUND IN TWO-PHASE WET STEAM SYSTEMS
I. S. Radovskii [1970] 10 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekh. Fiz. (USSR), no. 5, 1970 p 78–85
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The fundamental assertions of the thermodynamics of irreversible processes are applied to the process of acoustic wave propagation in a two-phase medium. Expressions are obtained which determine the dependence of the speed of sound in a wet steam medium on the degree of dryness and the degree of nonequilibrium of different relaxation processes accompanying acoustic wave propagation. In the limiting equilibrium case, these expressions reduce to known formulas obtained in equilibrium thermodynamics. Author

N71-17012# Lockheed Missiles and Space Co., Palo Alto, Calif.
DIFFRACTION BY A CHAOTICALLY INHOMOGENEOUS SCREEN
S. M. Rytov [1970] 11 p Transl. into ENGLISH from the book "Vvedenie v Statisticheskuiu Radiofiziku" Moscow, Nauka, 1966 p 339–352
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The simplest problem of a plane screen with random transmissivity f(x,y), on which a given monochromatic plane wave is normally incident, is examined. Omitting the time factor, the boundary condition from phi(x,y,z) on the z = 0 plane (directly at the exit from the screen) is found. The problem is considered with a field phi given on the boundary. Author

N71-17032# Iowa State Univ. of Science and Technology, Ames.
OPTICAL STUDIES OF CADMIUM
Roger James Bartlett (Ph.D. Thesis) Oct. 1970 105 p refs (IS-T-395) Avail: NTIS

The reflectivity and/or absorptivity of cadmium was measured from 0.15 to 20 eV. Measurements were made using polarized light with the electric vector of the incident radiation both perpendicular and parallel to the c-axis of the crystal. In the visible and infrared spectra, both polarization cases had strong absorption peaks. In the perpendicular polarization case, the main peak was at 0.98 eV and was attributed mainly to transitions between bands two and three along the LH symmetry line. Also in this polarization, there was an absorption edge at 0.29 eV. This may be due to transitions near the point K in the Brillouin zone. For the parallel polarization case, the main absorption peak was at 1.10 eV. The absorption here was attributed to transitions between bands two and three along Gamma K, Gamma M, and LH. No low-energy absorption edge was found for the parallel polarization case. Agreement between the experimental data and the theoretical calculations based on a nonlocal pseudopotential model was good. However, there was no agreement between the data and calculations based on a local pseudopotential model. Author (NSA)

N71-17033# Lockheed Missiles and Space Co., Palto Alto, Calif.
SCATTERING BY A STATISTICALLY ROUGH SURFACE (PERTURBATION METHOD)
S. M. Rytov [1970] 7 p Transl. into ENGLISH from the book 'Vvedenie v Statisticheskuiu Radiofiziku' Moscow, Nauka, 1966 p 352–359
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The electromagnetic wave scattering by an essentially flat, rough surface between two media, only one of which is penetrable to the waves, is discussed. The deviations of the surface from the z = 0 plane are described by a random field, and only the case of small, shallow roughness is considered. Equations are developed for approximating the solution to the wave equations. N.E.N.

N71-17165# National Physical Lab., Teddington (England). Quantum Metrology Div.
THE OPTICAL COUPLING OF THE PHOSPHOR SODIUM SALICYLATE TO PHOTOMULTIPLIERS, AND THE DETECTION OF UV RADIATION
G. H. C. Freeman and S. P. Talim Jun. 1970 49 p refs (NPL-Qu-11) Copyright. Avail: NTIS

These studies at 2537 A showed that: (1) sealed photomultipliers should be used for maximum efficiency but if they are not available a choice has to be made between phosphor/photomultiplier combinations and various photomultipliers with exposed photocathodes and dynodes; (2) sodium salicylate screens act as diffusers in the visible and as even-response detectors at shorter wavelengths when large spatial photocathode variations are not acceptable; (3) flexible fiber optics can be used when low coupling efficiency can be tolerated. Author (ESRO)

N71-17168# Joint Publications Research Service, Washington, D.C.
APPLIED PHYSICS
14 Jan. 1971 15 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 194, no. 6, 1970 p 1309–1317 (JPRS-52168) Avail: NTIS

CONTENTS:

1. COMPARISON OF ACOUSTIC EFFICIENCY OF SOME SOURCES OF EXPLOSION SOUND IN WATER M. I. Baleshkand p 1–6 refs (See N71-17169 07-23)
2. POSSIBILITY OF DETERMINING CHARACTERISTICS OF THE SURFACE LAYER OF SOIL BASED ON ITS THERMAL RADIO EMISSION K. Ya. Kondratyev et al p 7–11 refs (See N71-17170 07-13)
3. DETERMINATION OF CERTAIN CLOUD PARAMETERS USING A LASER RANGEFINDER Ye. G. Shvidkovskiy et al p 12–14 refs (See N71-17171 07-20)

N71-17169# Joint Publications Research Service, Washington, D.C.
COMPARISON OF ACOUSTIC EFFICIENCY OF SOME SOURCES OF EXPLOSION SOUND IN WATER
M. I. Baleshkand *In its* Appl. Phys. 14 Jan. 1971 p 1–6 refs Presented at the All-Union Sci. Res. Inst. of Geophys. Prospecting Methods, 10 Apr. 1970 (See N71-17168 07-23)
Avail: NTIS

The characteristics of high explosives for marine prospecting are reviewed, and oscillograms of pressure waves from TNT, gas combustion, and a pneumatic radiator are compared. It is concluded that in the 0 to 100 cps range the efficiency of the gas combustion explosion and of the pneumatic radiator can exceed that of TNT, and in the 100 to 1000 cps range TNT is superior in efficiency. N.E.N.

N71-17464*# Techtran Corp., Glen Burnie, Md.
THE ABSORBING PROPERTIES OF UNCONSOLIDATED AND LOOSELY BONDED TWO-PHASE MEDIA [O POGLOSHCHAShCHIKH SVOYSTVAKH NEKONSOLIDIROVANNYKH I SLABOSTSEMENTIROVANNYKH DVUKHFAZYKH SRED]
V. P. Gorbatova Washington NASA Feb. 1971 18 p refs Transl. into ENGLISH from Prikl. Geofiz. (USSR), no. 56, 1969 p 81–93

(Contract NASw-2037)
(NASA-TT-F-13426) Avail: NTIS CSCL 20N

The absorption coefficients for porous media saturated with water or petroleum are investigated. The effects of heat transfer, viscosity, and scattering are discussed and their dependence on the frequency of the propagating wave is examined. Various theoretical models are presented and compared. Author

N71-17516# Northeastern Univ., Boston, Mass.
THEORY OF FERROMAGNETISM IN NARROW BAND SOLIDS WITH APPLICATION TO EXPERIMENTS ON Co(x) Fe(1-x) S2
J. B. Sokoloff Dec. 1970 30 p refs
(NUB-2039) Avail: Issuing Activity

Ferromagnetism of the Hubbard model was studied away from the nearly half-filled band limit, in which this system was shown to be rigorously ferromagnetic. The motion of holes (i.e., sites not containing an electron) is used to obtain an expansion of the partition function in powers of inverse temperature. The approximation of keeping only contributions from those hole paths having electrons of one spin only is shown to be valid over a wide range of electron concentration. Using this method, the Curie temperature and magnetization are calculated and compared in detail with some transition metal disulfide experimental systems which are simple two band itinerant electron systems to which this model can be shown to be applicable. To understand these systems a discussion of their disordered nature is introduced. Compacson is also made with other narrow band theories, including Hubbard-s theory. Author

N71-17520*# Scientific Translation Service, Santa Barbara, Calif.
DIRECT OBSERVATION OF MAGNETIC FLUX LINES IN SUPERCONDUCTORS [PRIME POZOROVANI MAGNETICKYCH FLUXOIDU V SUPRAVODICICH]
U. Essmann Washington NASA Feb. 1971 13 p refs Transl. into ENGLISH from Cesk. Casopis Fys. (Prague), v. 19, no. 4, 1969 p 423–427
(Contract NASw-2035)
(NASA-TT-F-13458) Avail: NTIS CSCL 20C

Some results of Abrikosov's theory concerning the properties of the mixed state of type 2, superconductors and the method of revealing the flux-line lattice in these superconductors by depositing very small ferromagnetic particles are reviewed. Some results of the investigations using this method are presented, especially various types of defects (e.g. flux-line dislocations) in triangular flux-line lattice in type-2 superconductors and different structures of the intermediate state and their movement in type-1 superconductors. Author

N71-17744# Army Missile Command, Redstone Arsenal, Ala. Physical Sciences Lab.
ANALYSIS OF A CYLINDRICAL LASER RESONATOR HAVING A ZONED OUTPUT MIRROR
George A. Emmons 16 Sep. 1970 165 p refs
(AD-714981; RR-TR-70-22) Avail: NTIS CSCL 20/6

A theoretical analysis was performed on a zoned resonator to determine whether both resonator feedback and a focused output could be achieved with a single optical element. It was found that under certain conditions that well-defined modes do exist and that a focused output could be obtained. The resonator was formed by two parallel mirrors (circular, plane, and equal sized) symmetrically placed about a common axis. One mirror had a uniform reflectivity of unity. The other mirror was zoned. It consisted of alternately transmitting and totally reflecting concentric zones. The reflecting zones provided the resonator feedback and the transmitting zones provided the output coupling. The transmission zones were arranged in a manner similar to the transmission zones on a Freznel zone plate. Thus, the zoned mirror tended to focus the field coupled out of the resonator. Author (GRA)

N71-17758*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JPL BIBLIOGRAPHY 39-12
Aug. 1970 67 p refs
(Contract NAS7-100)
(NASA-CR-116543; JPL-Bibl-39-12) Avail: NTIS CSCL 14B

An annotated bibliography is presented for scientific and engineering work performed during the period. The publications are indexed by (1) author, (2) publication type and number, and (3) subject. A descriptive entry appears under the name of each author of each publication; an abstract is included with the entry for the first-listed author. Author

N71-17759*# Delaware Univ., Newark. Dept. of Physics.
RESEARCH STUDY OF THE PHOTOVOLTAIC EFFECT IN CADMIUM SULPHIDE Final Report
K. W. Boer 28 Oct. 1970 161 p refs
(Contracts NAS7-100; JPL-952668)
(NASA-CR-116542) Avail: NTIS CSCL 20L

Results of the first phase of a three-year effort to improve the quality of CdS photovoltaic cells are presented. The primary research effort is concentrated in four fields: (a) general theory related to the photovoltaic effect of heterojunctions, (b) production of materials with reproducible behavior (single crystals), (c) experimental and theoretical investigation of the behavior in the immediate neighborhood (100 A) of the CdS:Cu(x)S junction, and (d) analysis of changes in photoelectric parameters caused by radiation damage and by changes in the ambient atmosphere. The results include information on optimized doping and on grading of a heterojunction, successful growth and reproducible doping of CdS platelets, and reproducible production of CdS:Cu(x)S heterojunctions. It is shown that oxygen of the ambient atmosphere influences the photovoltaic properties only in a thin near-surface region and that this influence can be minimized by proper defect distribution. The threshold for X-ray damage is shown to depend on the ambient atmosphere and the defect distribution near the surface. Author

N71-17775# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
REMOTE SENSING OF UNDERWATER SOUND Final Report
Wayne K. Rivers 15 Oct. 1970 22 p refs
(Contract Nonr-991(08))
(AD-715132; GIT-A-519-F) Avail: NTIS CSCL 20/1

The work performed on a research program investigating interaction mechanisms for sensing underwater sound from a platform above the sea is reviewed. Two mechanisms were studied: the modulation of the electric permittivity of the salt water by the acoustic pressure and the free-surface vibration. The effects of these two mechanisms on the earths atmospheric electric field and on an electromagnetic wave reflected from the sea surface were considered. The magnitudes of the modulations produced were compared with the internal receiver noise background and with external background modulations produced by the environment. The conclusion is that at present even the most hopeful of the mechanisms, Doppler modulation of electromagnetic waves, is not useful for the stated purpose because of both technological limitations and adverse requirements on operational parameters. Author (GRA)

N71-17802* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HOT WIRE LIQUID LEVEL DETECTOR FOR CRYOGENIC

FLUIDS Patent
William A. Olsen, inventor (to NASA) Issued 20 Sep. 1966 (Filed 17 Jul. 1963) 7 p Cl. 73-295
(NASA-Case-XLE-00454; US-Patent-3,273,392; US-Patent-Appl-SN-295855) Avail: US Patent Office CSCL 20L

A hot-wire detector for cryogenic fluids is described that measures the propellant level in a fuel tank during space flight. Liquid hydrogen level gauging is performed by isolated hot wire sensors mounted in a rigid supporting structure and enclosed in a stillwell. As the level of liquid rises in the tank, a corresponding rise occurs in the stillwell and the hot wire is immersed; the decreased heat resistance potential of the wire is amplified and in turn actuates an indicating light. NASA

N71-17829# Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
POLYPAGOS: POLYCHROMIC PROGRAM FOR THE ANALYSIS OF GENERAL OPTICAL SYSTEMS Technical Report, Feb. 1969 – Nov. 1970
Silas Brewer 1 Sep. 1970 212 p refs
(Contract F04701-70-C-0059)
(AD-715262; TR-0059(6311)-1; SAMSO-TR-70-411) Avail: NTIS CSCL 20/6

The report discusses attempts to apply advanced concepts in computer technology to the analysis of optical systems. The early efforts went in to the Program for the Analysis of General Optical Systems (PAGOS). In addition to the basic program, the report covers changes in the transfer function computations, including: (1) the use of two-dimensional Fourier transforms to replace the convolution technique of PAGOS; (2) the generation of point spread functions; (3) a polychromic, i.e., multi-wavelength feature. The acronym came from adding the prefix POLY(chromic) to the acronym of the original version, hence POLYPAGOS. The document is not only descriptive of the program, it will function as a users manual. Author (GRA)

N71-17845# Naval Ordnance Lab., White Oak, Md.
REVIEW OF LIQUID STATE PROGRAM
W. M. Madigosky 25 Jul. 1970 30 p refs
(AD-715105; NOLTR-70-145) Avail: NTIS CSCL 7/4

The highlights of current and recent work are described as well as the present state of the theory of liquids. Finally, several areas for future study are discussed briefly. Author (GRA)

N71-17846# Stanford Univ., Calif. Microwave Lab.
BRAGG DIFFRACTION OF LIGHT FROM MAGNETOSTATIC AND MAGNETOELASTIC WAVES
David A. Wilson Mar. 1970 158 p refs
(Contract AF 19(628)-5545)
(AD-715253; ML-1836; AFCRL-70-0362; SR-5) Avail: NTIS CSCL 20/12

Theoretical and experimental investigations have been conducted on the use of Bragg and Raman-Nath diffraction of laser light from magnetostatic and magnetoelastic waves, propagating in Yttrium Iron Garnet (YIG). YIG is opaque to visible light, but highly transparent in the near infrared, and a light wavelength of 1.15 microns was therefore used. The properties of light diffraction from plane spin waves were derived, and shown to arise from the same magneto-optic effect which causes optical Faraday rotation. The linear magneto-optic coefficient m sub l, relating the change in dielectric constant to the rf magnetization components of the spin wave, was theoretically found to be 0.0000025/oe at a 1.15 microns wavelength. Experiments were carried out both for the purpose of verifying the predicted light diffraction behavior, and in order to use light diffraction as a tool in the study of magnetoelastic wave phenomena. Results are discussed. Author (GRA)

N71-17878# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF THE ATTENUATION COEFFICIENTS OF 0.6 TO 14 MICROMETERWAVES PASSING THROUGH FOG
I. L. Zelmanovich et al 8 Sep. 1970 16 p refs Transl. into ENGLISH from Vysokogornyi Geofizicheskii Inst., Nalchik, Tr. (USSR), no. 8, 1968 p 83–90
(AD-714786; FTD-HT-23-595-70) Avail: NTIS CSCL 20/6

Precise and approximate equations are derived for use in determining the coefficient of attenuation alpha 1/km of electromagnetic waves in mists and fogs. The simplified equations are given in unabsorbed polydispersed aerosols and absorbed polydispersed aerosols. Comparative calculations were made for several laser wavelengths in the spectral windows of atmospheric transparency. The optical properties of the water drops used as sols, droplet sizes used, and the mean droplet radii were given. Results obtained in a given calculation using a M-20 electronic computer and those obtained in using given equations are tabulated. They indicate that the use of these approximate equations results in errors which are only about 18 percent larger than those derived from precise and tedious equations. Electromagnetic waves in the 10-12 micron spectra passed through fogs with minimal attenuation. In heavy, optically dense fogs (for short wavelengths) the coefficient of attenuation was not selective. Author (GRA)

N71-18037# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MAGNETIC STRUCTURE OF ALLOYS ON A CHROMIUM BASE
Ye. G. Nesteranko et al 26 Oct. 1970 10 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Elektronnyye Svoistva Metallov i Splavov (Ukr. SSR), 1968 p 65–71
(AD-714875; FTD-HC-23-1386-68) Avail: NTIS CSCL 20/3

In studying the structure of chromium by neutron diffraction methods it was determined that chomium is antiferromagnetic below the temperature of 40 degrees centigrade. It was noticed that the dependency of the intensity of the magnetic reflection (100) of polycrystalline chromium on the temperature of the specimen has a complex character; it represents, as it were, two curves which make it possible to speak of two Neel points: one at 40 degrees centigrade and the other at 200 degrees centigrade. The latter circumstance is related to the influence of a dislocated structure on the magnetic structure. Recently interest has grown in investigating the magnetic structure of chromium and its alloys. The magnetic structure of alloys of chromium with manganese have been investigated most completely with neutron diagrams. It is clear from these works that the addition of manganese to chromium leads to an increase in the mean magnetic moment of an atom. Author (GRA)

N71-18065# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
SIMPLE MODEL FOR AMORPHOUS ANTIFERROMAGNETS
Ryusuke Hasegawa Dec. 1970 10 p refs /tr AEC Research and Develop. Rept. No. 13
(Contract AT(04-3)-822)
(CALT-822-16) Avail: NTIS

A molecular field model for amorphous antiferromagnets is considered by taking into account the structural fluctuations which could exist in amorphous materials. The results show that the fluctuations shift the susceptibility versus temperature curves toward or away from the temperature axis with changes in the Neel temperatures. The direction of the shift depends on the sign and on the size of the fluctuations in the exchange integrals. The present results are consistent with the magnetic properties of an amorphous Mn-P-C alloy. Author (NSA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N71-16928 Atomic Energy Commission, Washington, D.C.
MEASUREMENT AND CALCULATION OF STRENGTH FUNCTION VALUES FOR NUCLEI IN THE 3s-RESONANCE RANGE
K.-N. Mueller et al [1970] 83 p refs Transl. into ENGLISH of West German report KFK-1114
(EURFNR-741; DWR-1497; KFK-1114) Avail: NTIS

Total neutron cross sections of the isotopes Ti-49 and Cr-53 were measured in the energy range of 17-250 keV at the Karlsruhe Van de Graaff accelerator, and analyzed with an R-matrix multilevel formula to obtain the resonance parameters. A spin-independent strength function value of 3.2 + or − 0.7 was obtained for Ti-49 and 4.1 + or − 0.9 for Cr-53. The analysis of the cross section above 120 keV indicates a spin dependence of the Cr-53 strength function. To investigate the fluctuations of experimental strength function values around the average curve described by the optical model, strength functions were calculated for 20 nuclei in the region of the 3s resonance. The calculations are based on a semiempirical ansatz and explain the fluctuations as variations of the doorway-state density in the binding-energy region. The density of these states was calculated in the framework of a shell model. Pairing correlations were taken into account according to the superconductivity theory of the nucleus.
Author (NSA)

N71-16929# Atomic Energy Commission, Washington, D.C. Div. of Technical Information.
SEARCH FOR THREE-VECTOR CORRELATIONS IN DECAY OF POLARIZED NEUTRONS
B. G. Erozolimskii et al [1970] 18 p refs Transl. into ENGLISH of Akad. Nauk SSSR, Moscow, Inst. At. Engeri, report IAE-1891
(AEC-tr-7156; IAE-1891) Avail: NTIS

The value of the constant D was determined for triple correlation between the vectors of neutron spin, electron momenta, and antineutrino momenta: −0.01 + or − 0.01; this corresponds to the phase difference between the axial-vector and vector constants of the weak interaction omega = 181.3 + or − 1.3.
Author (NSA)

N71-17003# Atomic Energy Board, Pretoria (South Africa).
EQUATIONS FOR THE COMPUTER COMPUTATION OF THE KINETIC ENERGY DISTRIBUTIONS OF FISSION FRAGMENTS RELEASED FROM NUCLEAR FUEL SURFACES BY RECOIL
T. T. Van Reenan and W. J. De Wet Mar. 1970 7 p refs
(PEL-198) Avail: AEC Depository Libraries

The kinetic energy distributions of single fission fragment mass lines, as well as the global kinetic energy distribution, incorporating all mass lines, can be evaluated. Final equations are given for thick fuel sources. These were applied to U and UO2 sources for which the results are presented graphically.
Author (NSA)

N71-17004# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali.
REPORTS PRESENTED AT '15TH INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS'
24 Jul. 1970 43 p refs Conf. held at Kiev, Aug.–Sep. 1970
Its Nota Interna No. 489
(LNF-70138; CONF-700806-35) Avail: AEC Depository Libraries

The Bhabha scattering process e(+) + e(−) yields e(+) + e(−) was investigated in an experiment carried out in the Frascati storage ring, at total energies of the colliding beams ranging from 1.5 to 2.4 GeV. Measurements of e(+) e(−) yields muon(+) muon(−) interactions are extended to sq q = 4(sq E) approximately equal to 4 sq(GeV). The results are consistent with the hypothesis of muon-electron universality and the validity of quantum electrodynamics at the large time-like momentum transfers involved in the experiment. A preliminary analysis is also made of hadron production in the interactions e(+) + e(−) yields pion(+) + pion(−) and e(+) + e(−) yields m pion(+) + m pion(−) + neutron pion(0) at 1.6 to 2.0 GeV, where n is less than or equal to 0 if m is less than 1 if m = 1, and where hadrons are indicated for simplicity as pions.
NSA

N71-17030# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
ANALYSIS BY NUCLEAR REACTION FOR OXYGEN AND CARBON IN THIN LAYERS AND THE SURFACE OF METALS
L. Quaglia et al [1970] 24 p refs Transl. into ENGLISH from Nucl. Instr. Methods (Amsterdam), no. 68, 1969 p 315–324
(LIB/Trans-299) Avail: AEC Depository Libraries

A preliminary study was made to define valid experimental conditions for determining the quantity of oxygen and carbon retained by adsorption or chemical reaction on the surface of high-purity metals. A method of analysis by charged-particle nuclear reactions was applied. The first experimental results are given for aluminum metal. The results are compared to those obtained for the same samples, using the activation analysis technique with 2-MeV tritons.
Author (NSA)

N71-17031*# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
SOME RECENT TRENDS AND ADVANCES IN MOLECULAR BEAM RESEARCH
I. Amour, J. E. Jordan (Brown Univ.), and E. A. Mason [1970] 29 p refs Supported in part by NASA and NSF
(Contract N00014-67-A-0204-004)
(NASA-CR-116434; AD-699539; TR-8(24) Avail: NTIS CSCL 7/4

A review is presented of selected recent developments in experiments involving two-body collisions. The review discusses advances associated with high and low energy beams, and also with beams of intermediate energy. In the description of new experimental techniques, mention is made of methods for internal state selection, production of moderate energy beams and the use of energy analysis of products as a method for detecting inelastic processes such as rotational and vibrational excitation and de-excitation. In discussing experimental results, examples are given of systems where such inelastic events have been observed. With respect to the determination of intermolecular potentials, it is pointed out that for several systems there is good agreement between experiment and theory and also between the results from different laboratories. The successful use of inversion procedures for deducing intermolecular potentials from scattering experiments without assuming a semi-empirical functional form is shown in the determination of potentials where it is necessary to take account of both repulsion and attraction.
Author (GRA)

N71-17034# Brown Univ., Providence, R.I. Dept. of Physics.
SUMMING SOFT PSEUDOSCALAR PIONS
H. M. Fried [1970] 19 p refs Supported in part by AEC

(NYO-226-TA-224) Avail: NTIS

Momentum transfer dependent damping of the nucleon form factors due to the virtual exchange of soft, nonchiral, pseudoscalar pion pairs is estimated. When chirality is enforced, by embedding the calculation in the nonlinear sigma model, these soft effects are shown to cancel to all orders in the strong coupling. By themselves, the contributions described here do not easily fit the experimental data. Author (NSA)

N71-17038# Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.

HIGH ENERGY PHYSICS GROUP Annual Progress Report

15 Oct. 1970 92 p refs

(Contract AT(04-3)-511)

(UH-511-87-70) Avail: NTIS

Both experimental and theoretical research are discussed. The discussion includes spark chamber and bubble chamber experiments and the instrumentation. A list of publications is given. NSA

N71-17042# European Organization for Nuclear Research, Geneva (Switzerland).

GAS TARGET FOR SLOW MESON EXPERIMENTS [GAZOVAYA MILTSEN DLYA EKSPERIMENTOV S MEDLENNYMI MEZONAMI]

P. F. Ermolov et al Nov. 1969 5 p refs Transl. into ENGLISH of Russian report JINR-P-2711

(CERN-Trans-69-29) Avail: AEC Depository Libraries

The gas target is described which is intended to operate with slow mesons at a gas pressure up to 100 atm. Two scintillation counters are placed inside the target. Thereby an effective selection of meson stoppings in gas is attained. The latter is equal to 70% from the total number of stoppings registered by the electronic equipment at a hydrogen pressure of 50 atm. Author (NSA)

N71-17049# National Accelerator Lab., Batavia, Ill.

PARTICLE BEAMS: 1969 SUMMER STUDY, VOLUME 1

Arthur Roberts, ed. 1969 472 p refs Sponsored by AEC

(TID-25473-Vol-1) Avail: NTIS; HC$6.00/MF$0.95

Research activities in particle beams are reported. Some topics discussed include: (1) separated beam of K mesons and antiprotons, (2) electron neutrino interactions, (3) analysis of the parameters of aRF separator, (4) general-purpose target station, (5) neutral-beam channel which permits detectors within 10 meters of the target, and (6) installation of steering magnets in the proton beam line upstream of the EPB target. F.O.S.

N71-17188# Brookhaven National Lab., Upton, N.Y. Div. of Technical Information.

GLAUBER CORRECTIONS AND THE INTERACTION BETWEEN HIGH ENERGY HADRONS AND NUCLEI

V. N. Gribov Jul. 1970 21 p Transl. into ENGLISH from Zh. Eksp. Teor. Fiz. (USSR), v. 56, no. 3, 1970 p 892-901 Sponsored by AEC

(BNL-tr-358) Avail: NTIS

It is pointed out that the arguments leading to the cube root of A sq. law for the nuclear cross sections and the equation for the total cross section including the Glauber correction for scattering by a deuteron are essentially nonrelativistic in character. The conditions for the applicability of the nonrelativistic theory, and screening at very high energies, are discussed. Pion-deuteron scattering is considered. NSA

N71-17233# California Univ., Berkeley. Lawrence Radiation Lab.

THE RHO-MESON(0) OMEGA-MESON INTERFERENCE PARAMETERS IN DIFFRACTIVE PHOTOPRODUCTION OF VECTOR MESONS ON HYDROGEN

K. C. Moffeit, H. H. Bingham, W. B. Fretter, W. J. Podolsky, M. S. Rabin et al Aug. 1970 6 p refs

(Contract W-7405-eng-48)

(UCRL-19753) Avail: NTIS

The reaction gamma proton yields pion(+)pion(-) proton was examined for evidence of rho-meson(0) omega-meson interference. The result, obtained using a hydrogen bubble chamber, agrees with the high-statistics Daresbury result using photoproduction on carbon. Author (NSA)

N71-17236# Helsinki Univ. (Finland). Dept. of Technical Physics.

IRESINT: A COMPUTER PROGRAM TO CALCULATE RESONANCE INTEGRALS

Frej Wasastjerna [1970] 80 p

(ND-18281; Rept-508169) Avail: AEC Depository Libraries

The IBM S/360 FORTRAN 4 G program IRESINT is described. This program computes heterogeneous resonance integrals for both fissile and non-fissile nuclides, and for resolved and unresolved resonances. The resolved resonances are computed according to the intermediate resonance approximation. The geometry has to be a regular square or hexagonal lattice of cylindrical fuel rods. Author (NSA)

N71-17242# Hawaii Univ., Honolulu.

OBSERVATION OF A 2400-MeV 5 PION MASS ENHANCEMENT IN 8-PRONG PION(-) PROTON EVENTS AT 12 GeV/c

A. D. Johnson, M. W. Peters, V. J. Stenger, and A. Yee Aug. 1970 9 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, Aug.-Sep. 1970

(Contract AT(04-3)-511)

(UH-511-77-70; CONF-70806-47) Avail: NTIS

An enhancement centered at M = 2420 + or - 25 MeV is observed in six-prong pion(-) proton interactions at 12 GeV/c in a hydrogen bubble chamber. The width of this enhancement and the branching ratio for the rho-meson-rho-meson pion decay mode were determined. Also the Delta (++) (1236) and rho meson(0) (765) resonance production were observed. NSA

N71-17265# Syracuse Univ., N.Y. Dept. of Physics.

SYMMETRY BREAKING AND SPIN ZERO MASS SPECTRUM

J. Schechter and Y. Ueda Jul. 1970 35 p refs Sponsored by AEC

(SU-1208-230; NYO-3399-230) Avail: NTIS

The mass spectrum is discussed in a very general chiral SU(3) x SU(3) model of pseudoscalar and scalar mesons. The case of an exactly symmetric Lagrangian and spontaneous breakdown is covered as well as the more realistic case when there is also some intrinsic symmetry breaking in the Lagrangian. The treatment is facilitated by the derivation of a mass formula which holds for all situations. In the realistic case the structure of the theory forces the mass of the ninth pseudoscalar meson to come out right and leaves one with the freedom to choose the masses of all scalar mesons (except the kappa) as high as one likes. The structure of the intrinsic symmetry breaking term is predicted. Some discussion of the baryons in this model is also included and the corrections to the Cabibbo theory of semi-leptonic hyperon decay are estimated. Author (NSA)

N71-17288# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

RESONANCE CROSS SHIELDING IN REACTOR ANALYSIS

R. B. Kidman, C. W. Lindenmeier, and R. E. Schenter Jul. 1970 35 p refs
(Contract AT(45-1)-1830)
(BNWL-1509) Avail: NTIS

Accidental overlap between the resonances of distinct isotopes is ignored in the present structure factor method. To ascertain the effect of accidental overlap and to develop possible modifications of the structure factor method, the specific overlap between Pu-239 and U-238 is analyzed. The basic approach was to modify ETOX subroutines enabling them to generate cross shielded f-factors that account for self shielding and accidental overlap. A comparison between the cross shielded and the normal self-shielded f-factors then reveals any accidental overlap effects. Significant overlap effects were not detected between resolved and unresolved resonances nor between unresolved and unresolved resonances. However, effects as large as 6% resulted from the overlap between the resolved resonances of U and Pu. Author (NSA)

N71-17290# International Business Machines Corp., Hopewell Junction, N.Y. East Fishkill Facility.
NUCLEAR METHODS FOR THE DETERMINATION OF DIFFUSION PROFILES
B. J. Masters *In* NBS Silicon Device Process. Nov. 1970 p 132–140 refs (See N71-17276 07-26)
Avail: SOD $5.50

Owing to the ease of detecting radioactive material in small amounts, both radioactivation and radiotracer techniques are considered as means for obtaining impurity profiles in silicon. These radiochemical methods yield knowledge of the total concentration of specific impurities as a function of depth, regardless of the physical or chemical form in which they may be present. The application of these techniques to various device structures, and the uncertainties associated with radiochemical profiling, are discussed, together with the potential use of scattering techniques for the analysis of diffused layers. Author

N71-17321# Virginia Polytechnic Inst., Blacksburg. Dept. of Chemistry.
MOESSBAUER EFFECT STUDIES ON Eu-151 IN MIXED OXIDE STRUCTURES
G. W. Dulaney and A. F. Clifford [1970] 20 p refs
(Contract AT(40-1)-3603)
(ORO-3603-7) Avail: NTIS

Mossbauer studies have been carried out on ternary europium (III) oxides in an attempt to explain the fact that the observed line widths are much greater than theoretical. Evidence of quadrupole splitting has been found in $Eu_2Ti_2O_7$, $Eu_2Sn_2O_7$, $EuAlO_3$ and $EuScO_3$, all of which have the europium atom presumably in a site of high symmetry. The quadrupole coupling constant for Eu-151 has been found to be in agreement with previous reports. Absorption efficiencies are correlated with crystal rigidity and isomer shifts with ionicity and mass. Author

N71-17322# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Nuclear Science.
PRECISION OF TANK CAPTURE CROSS SECTION MEASUREMENTS
Robert C. Block and Robert W. Hockenbury [1970] 13 p refs Presented at EANDC Symp. on Neutron Standards and Flux Normalization, Argonne, Ill.
(Contract AT(30-1)-328)
(RPI-328-202; CONF-701002-1) Avail: NTIS

The precision of neutron capture cross section measurements with large liquid scintillators, is reviewed with regard to recently reported measurements. A precision of 3 percent is currently obtained for thermal measurements while a precision of 10 percent is reported for heavy nuclei in the keV region. Anticipated improvements in the determination of the neutron flux dependence with energy and capture spectra measurements in the keV region should enable future tank measurements to achieve an accuracy of 3 to 5 percent in absolute capture cross sections in the keV region. On the other hand, a relative measurement in the keV region of two capture cross sections could conceivably be made to an accuracy of 5 percent, and with great care a precision of 2 to 3 percent should be possible. Author (NSA)

N71-17340# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
EXCITED STATES OF DEFORMED NUCLEI WITH 93, 95, and 97 NEUTRONS. 2: THE DECAY Tm 163 YIELDS Er 163
A. A. Abduraszakov, K. Ya. Gromov, T. A. Islamov, and H. Strusnyi 1970 19 p refs In RUSSIAN
(JINR-P6-5132) Avail: AEC Depository Libraries

The level scheme of Er-163 was investigated in the decay of Tm-163, measuring the conversion electron spectrum and the gamma-ray spectra. The measurements of the conversion electron spectrum were performed with the aid of a magnetic beta-spectrograph with a resolution of 0.05%. The gamma-ray spectra were measured with germanium detectors. About 60 transitions were observed. The multipolarities of the majority of gamma transitions were determined. Many of the gamma transitions were introduced into a level scheme of Er-163. Author (NSA)

N71-17341*# Boeing Co., Seattle, Wash.
APPLICATION OF RADIOACTIVE TRACER TECHNIQUES TO FLOW DECAY PROBLEMS Final Interim Report, 26 Mar.–26 Oct. 1970
Kent E. Pullen Dec. 1970 88 p refs Prepared for JPL
(Contract NAS7-779)
(NASA-CR-116404; D180-12741-1) Avail: NTIS CSCL 20H

The main object of the program was to develop a sensitive tool which could be used to detect the time, place, and degree of deposition of metal contaminants within various components of a propellant feed system. Such a tool was successfully developed and applied to flow studies involving nitrogen tetroxide and hydrazine. Author

N71-17342*# Oak Ridge National Lab., Tenn. Physics Div.
AUGER SPECTROSCOPY OF SIMPLE GASEOUS MOLECULES
William Ervin Moddeman (Ph.D. Thesis–Tenn. Univ.) Sep. 1970 162 p refs
(Grant NGL-43-001-021; Contract W-7405-eng-26)
(NASA-CR-116411; ORNL-TM-3012) Avail: NTIS CSCL 20H

If the K- and L-shell electrons are involved in the Auger transition, the interaction is referred to as a K-LL Auger process. The high resolution K-LL Auger spectra of some simple gaseous molecules were recorded and analyzed. Each spectrum was excited by electron impact. In addition to electron excitation, some portions of each spectrum were induced by X-ray irradiation. Also, the 1s-photoelectron spectra in a few cases were recorded. In the analysis of an Auger spectrum that was excited by electrons, four different energy regions were located. The division of a spectrum in four regions was accomplished by using a very simple shell model. The satellite processes that were considered in the analysis are (1) Auger electrons that resulted from the decay of autoionization and monopole excited and ionized states and (2) Auger lines that appear from ionizations and excitations by the normal Auger electrons. From the identification of the normal lines in the Auger spectra, energy values were calculated for: (1) the minimum energy required for double electron removal for the ground state of a neutral molecule and (2) the second ionization energy for a given molecular orbital. Author

N71-17356# Los Alamos Scientific Lab., N.Mex.
THE O(h(k-j) OMEGA(D(K)f,h) BOUNDS ON SOME SPLINE INTERPOLATION ERRORS
Blair K. Swartz May 1970 73 p refs
(LA-4477) Avail: NTIS

Some holes are filled in the existing edifice of error bounds associated with spline interpolation at the knots. Piecewise-continuous (and smoother) functions are interpolated by splines of high order under a variety of exact or approximated boundary conditions. Similar interpolation of perturbed data is also considered. The proofs of the convergence rates are of an elementary nature, using only the tools of advanced calculus. Author

N71-17357# California Univ., Berkeley. Lawrence Radiation Lab.
REACTION PION(+) PROTON YIELDS DELTA(++) A2 AT 3.7 GeV/c
K. W. J. Barnham, G. S. Abrams, W. R. Butler (David Lipscomb Coll.), D. G. Coyne (Princeton Univ.), G. Goldhaber et al Jul. 1970 10 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug.–4 Sep. 1970 and the 4th Intern. Conf. on Resonant Particles, Athens, Ohio, 15–17 Jun. 1970
(Contract W-7405-eng-48)
(UCRL-20050; CONF-700806-43; CONF-700627-1) Avail: NTIS

Preliminary results are presented for associated production of A2(0) and Delta(++) in the reaction pion(+) + proton yields proton + 2 pion(+) + pion(−) + pion(0) at 3.7 GeV/c. A fairly narrow A2(0) signal is observed, and some evidence is seen for a dip in the differential cross section for production of this state at t approximates 0.6 Ge(sq V) or t' = 0.15 to 0.35 Ge(sq V). NSA

N71-17358# Syracuse Univ., N.Y. Dept. of Physics.
SOME NEW RESULTS ON SYMMETRY BREAKING IN A CHIRAL MODEL
J. Schechter and Y. Ueda Jul. 1970 24 p refs Sponsored by AEC
(SU-1206-228; NYO-3399-228) Avail: NTIS

The mass spectrum of the spin-zero mesons is investigated in a very general chiral SU(3) symmetry model. A striking tendency for the ninth pseudoscalar mass to come out in the right region is noted. Electromagnetic symmetry breaking is included and the meson electromagnetic mass shifts can be correlated with those of the baryons when the strength of the electromagnetic symmetry breaking is the same order of magnitude as the chiral breaking. Author (NSA)

N71-17359# California Univ., Irvine. Dept. of Physics.
STUDY OF NEW HEAVY BOSONS IN PROTON-ANTIPROTON INTERACTIONS Progress Report, 1 Oct. 1969–30 Sep. 1970
J. Schultz and P. Condon Sep. 1970 26 p refs
(Contract AT(04-3)-34)
(UCI-34-P-149-1) Avail: NTIS

Experimental research on new heavy bosons in antiproton-proton interactions is reported. The discussion covers resonance formation experiments, elastic processes, resonance production experiments, and other results. NSA

N71-17360*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPIN EXCHANGE IN COLLISIONS BETWEEN He(+) IONS
G. M. Ressler and F. G. Major Jan. 1971 26 p refs
(NASA-TM-X-65442; X-521-70-434) Avail: NTIS CSCL 20H

The spin exchange cross section for the collision between two He(+) ions is calculated in the impact parameter approximation with the use of a variational technique to determine the He(+) - He(+) interaction potential due to exchange. It is found that the spin exchange cross section reaches a maximum of 3.66 pi (a sub 0) squared at a relative impact energy of 85 eV and falls rapidly to zero below 10 eV. As applied to a proposed ionic frequency standard, the results indicate that relaxation effects due to spin exchange are negligibly small. Author

N71-17405# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA
1970 122 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 14, no. 5, 1969 p 425–554 Supported by AEC and NSF
(AEC-TR-7027/5; TT-69-50012/5) Avail: NTIS

Methods used for measuring magnetic moments of short-lived nuclear states are reviewed. Principles, possibilities, and limitations of the methods based on Mossbauer's effect and on angular correlations of nuclear radiations are presented in more detail, and some recent methodical refinements are described. Author

N71-17406# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA
1970 117 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 14, no. 6, 1969 p 555–678 Sponsored by AEC and NSF
(AEC-TR-7027/6; TT-69-50012/6) Avail: NTIS

Alcoholic solutions of the essential calamus oil luminophor were found to glow after having been irradiated with UV- or X-rays at low temperatures. As the temperature of the luminophor is raised, the intensity of phosphorescence increases and attains maximum, past which it diminishes with further increase in temperature. Author

N71-17407# California Univ., Berkeley. Lawrence Radiation Lab.
PROTON EXCHANGE RATES AND NUCLEAR MAGNETIC RESONANCE RELAXATION IN AQUEOUS SOLUTIONS OF A HYDROLYTIC TRIMER OF Cr(3) ION
Ronald Tse Lee (Ph.D. Thesis) Aug. 1970 82 p refs
(Contract W-7405-ENG-48)
(UCRL-19639) Avail: NTIS

The temperature dependence of the transverse NMR relaxation time of protons in aqueous solutions containing a hydrolytic trimer of Cr(III) was studied as a function of acidity at 60 and 100 Mhz. The temperature dependence of the longitudinal relaxation time in these solutions at 11 MHz was also studied as a function of acidity. The chemical shifts of the bulk proton signal with respect to pure water were measured as a function of temperature at 60 MHz to gain additional information. The particular relaxation mechanism for T sub 1 is interpreted as being a dipole-dipole interaction interrupted by rotation and electronic relaxation. The mechanisms found to be operative for the T sub 2 data are scalar coupling interrupted by electronic relaxation and dipole-dipole coupling. Author

N71-17413*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CLASSICAL RELAXATION OF Br2 MOLECULES IN AN ARGON HEAT BATH
Ronald Razner Washington Feb. 1971 56 p refs
(NASA-TN-D-6180; E-5904) Avail: NTIS CSCL 20H

Classical trajectories for Br2-Ar collisions were calculated and used to study energy transfer mechanisms for Br2 molecules in a heat bath of Ar atoms at temperatures between 300 and

10,000 K. Probability distributions for internal energy changes and angular momentum transfers per collision were obtained by Monte Carlo averaging. At temperatures above 1000 K, coupling between vibrational and rotational motions in the Br2 molecule was found too strong to be ignored. Implications of this and other results for studies of reaction rates and relaxation mechanisms are discussed. Author

N71-17417# Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY OF ATOMIC AND MOLECULAR PROCESSES FOR JANUARY–DECEMBER 1969
Nov. 1970 65 p refs Sponsored by AEC
(ORNL-AMPIC-13) Avail: NTIS

Literature related to atomic and molecular collision research is presented in an annotated bibliography. Bibliographical sources consist of eighty-two scientific journals and three abstracting journals. References are cataloged under ten major categories with appropriate subcategories. For each entry the following information is indicated: the reactants studied, the type research (experimental or theoretical), the energy range, the author(s), and journal or book reference. Author (NSA)

N71-17418# Atomic Energy Commission, New York. Health and Safety Lab.
MANUAL OF STANDARD PROCEDURES
John H. Harley, ed. Sep. 1970 554 p
(NYO-4700) Avail: NTIS HC$6.00/MF$0.95

Procedures that have been tested over an extended period of time with many samples are included. The divisions within the manual are: general, data section, radiation measurements, sampling, chemical procedures, fallout methods, and specifications. NSA

N71-17419# California Univ., Berkeley. Lawrence Radiation Lab.
RESONANCE PRODUCTIONS IN K(+) p INTERACTIONS AT 4.6 GeV/c, and 9 GeV/c
Chumin Fu (Ph.D. Thesis) 10 Aug. 1970 135 p refs
(Contract W-7405-eng-48)
(UCRL-19809) Avail: NTIS

A study is made of the reaction K(+) proton yields K(+) pion(−) pion(+) proton at GeV/c. The Brookhaven National Laboratory 80-in. hydrogen bubble chamber was employed for both experiments. It is found that one-pion exchange (OPE) plays a very important role in both the K(890)(0) Delta(1236)(++) and the K(1420)(0) Delta(1236)(++) double resonance production and the low Delta(1236)(++) pion(−) mass enhancement in the K(+) pion(−) Delta(1236)(++) channel. The decay properties of the double resonance channels indicate that OPE dominates over a larger t range in the lower energy (4.6 GeV/c) data than in the higher energy (9 GeV/c) data. Problems involved with the extrapolation into the small K(+) pion(−) mass regions are discussed. The importance of the contribution from the extrapolation and its implication to the K pion scattering analysis are also investigated. Author (NSA)

N71-17420# Rockefeller Univ., New York.
REGGE ANALYSIS OF ELECTROPRODUCTION AND PHOTOPRODUCTION
Heinz Pagels 1970 11 p refs
(Contract AT(30-1)-4204)
(NYO-4204-6) Avail: NTIS

By combining the Froissart–Gribov definition of the partial wave amplitude with the DGS representation the analytic properties of the Regge residue functions beta(q squared, alpha sub i) in q squared = virtual photon mass are established. The analysis suggests a simple extrapolation from the photoproduction data on nucleons at high energy to electroproduction in the deep inelastic region. Author (NSA)

N71-17434# California Univ., Berkeley. Lawrence Radiation Lab.
OPTICAL SPECTROSCOPIC STUDIES OF METAL ATOMS AND MOLECULES IN THE LOW TEMPERATURE MATRICES
Chin-An Chang (Ph.D. Thesis) Aug. 1970 159 p refs
(Contract W-7405-ENG-48)
(UCRL-19662) Avail: NTIS

Lead was trapped in various matrices to study the matrix effects on both the atomic and molecular lead absorption spectra. Pb was also codeposited with Ag to study the possible surface diffusion on the target. The observed spectra of Pb at various temperatures are correlated with some model calculations to get information about the origin of the matrix effects. The earlier theories on the matrix effects are discussed. A model is proposed to account for the observed matrix effects on most of the trapped metal spectra. Author

N71-17435# Cornell Univ., Ithaca, N.Y. Materials Science Center.
COLLECTIVE AND PARTICLE MODES IN THE CLASSICAL LIQUID
Peter Joseph Ortoleva, Jr. (Ph.D. Thesis) Sep. 1970 116 p refs
(Contract AT(30-1)-3326)
(NYO-3326-29; Rept-1387) Avail: NTIS

Dense single component classical liquids are studied via time dependent correlation functions. The work is specifically addressed to high frequency and short wavelength phenomena near equilibrium as measured by probes such as thermal neutrons. Several methods including the use of approximate normal modes and average particle motion are employed. The autocorrelation function of the phase space density plays a central role in the description as it introduces the interplay of single particle and collective aspects of the system in a natural way. Several models are presented based on the use of simple density modes and liquid phonon coordinates. The formalism of memory functions is used to analyze the results and provide a systematic framework for improvements. Author

N71-17436# Sandia Corp., Albuquerque, N.Mex.
EMISSION CROSS SECTIONS FOR H(+), Na(+), Ne(+), Rb(+), INCIDENT ON MOLECULAR NITROGEN
James M. Hoffman, Glenn H. Miller, and Grant J. Lockwood Oct. 1970 62 p refs Sponsored by AEC
(SC-RR-70-695) Avail: NTIS

Selected radiations from a nitrogen target for incident ions of H, Ne, Na, and Rb were examined in the energy range 30 to 100 keV. In particular, the N2(+) (3914 A), N2 (3371 A), and N(+) (3995 A, 4026 A, 4043 A, 4080 A, 5003 A, 5680 A) absolute emission cross sections were measured. The H(+) data are compared to values previously reported. The use of Ne(+) and Na(+) permits a comparison for similar incident masses, but different chemical structure. On the other hand, the role of incident particle mass for similar chemical structure was studied by comparison of Na(+) and Rb(+). Included are recommendations for a more comprehensive program. Author (NSA)

N71-17437# Syracuse Univ., N.Y. Dept. of Physics.
ELECTROMAGNETIC PERTURBATION OF THE PSEUDOSCALAR MASS SPECTRUM
J. Schechter and Y. Ueda Jul. 1970 28 p Sponsored by AEC
(SU-1206-229; NYO-3399-229) Avail: NTIS

Using the formalism developed previously, electromagnetic perturbations are investigated in a rather general chiral SU(3) symmetry model of mesons. The meson and octet baryon mass shifts can be successfully correlated and it is found that the electromagnetic breaking term in the Lagrangian is of the same order of magnitude as the chiral symmetry breaking term. Also the speculation that all strong symmetry breaking may be of electromagnetic and weak origin is discussed. Author (NSA)

N71-17438# Wayne State Univ., Detroit, Mich. Dept. of Physics.
NUCLEAR MAGNETIC RESONANCE STUDY OF THE CRYSTALLINE COMPOUNDS OF THE Nb-be(x) SYSTEM
Robert A. Bennett and H. O. Hooper [1970] 25 p refs
Sponsored by AEC
(COO-1700-12) Avail: NTIS

Nuclear magnetic resonance techniques were employed to study powder samples of the compounds NbBe2, NbBe3, Nb2Be17 and NbBe12. The nuclear quadrupole coupling constants and Knight shifts were determined for the Nb sites in these compounds. The Nb-93 NMR from NbBe2 is a single unsplit line with no quadrupole coupling constant and with a Knight shift of 0.70 + or − .03%. The Nb-93 NMR from NbBe3 indicates the presence of three Nb sites. The beryllium NMR was examined, yielding little information, since no measurable quadrupole interaction or Knight shift were present. This study illustrates the variety of environments of the niobium nuclei among these beryllides and within a single beryllide. The NMR results are discussed in relation to the results of X-ray studies of these compounds. Author (NSA)

N71-17439# Rockefeller Univ., New York.
DEEP INELASTIC e-p STRUCTURE FUNCTIONS IN A LADDER MODEL WITH SPIN 1/2 NUCLEONS
Stephen Blaha [1969] 46 p refs
(Contract AT(30-1)-4204)
(NYO-4204-4) Avail: NTIS

The asymptotic behavior of the inelastic electron-proton structure functions is found using a ladder model for the virtual Compton amplitude. Neutral vector mesons are exchanged between the (spin 1/2) proton legs. In addition, this model (with slight modifications) gives the asymptotic behavior for a ladder model in which pseudoscalar mesons are exchanged, and the asymptotic behavior for a truss bridge graph model in a mixed field theory. In addition, it is found that the structure functions are essentially Bessel functions. Author (NSA)

N71-17452# Argonne National Lab., Ill. Applied Physics Div.
EXPERIMENTAL RESULTS FOR ZPR-3 ASSEMBLIES 58 AND 59
J. M. Stevenson, J. M. Gasidlo, V. C. Rogers, G. G. Simons, and R. O. Vosburgh Apr. 1970 41 p refs
(Contract W-31-109-eng-38)
(ANL-7695) Avail: NTIS

Results of measurements made on ZPR-3 Assemblies 58 and 59 are presented. These assemblies had a simple Pu-graphite cell and differed in the reflector, which was depleted U (in Assembly 58) or Pb (in Assembly 59). Critical mass, fission-rate and perturbation distributions, central fission ratios, central perturbations, the Doppler reactivity effect in a natural UO2 sample, and the central neutron spectrum by the proton-recoil method are presented. Some of the experiments were performed in both assemblies, others in only one. Author (NSA)

N71-17482# Gulf General Atomic, San Diego, Calif.
PULSE RADIOLYSIS STUDIES OF AQUEOUS SOLUTIONS OF AMINOTHIOLS AND COMPOUNDS RELATED TO NUCLEIC ACID Three Year Summary Report
L. M. Theard, F. C. Peterson, and R. L. Voigt 15 Jun. 1970 180 p refs
(Contract AT(04-3)-167)
(GA-10208) Avail: NTIS

Developments are reported for studies on: nanosecond pulse radiolysis of aqueous thymine solutions; and steady state and pulse radiolysis of aqueous chloride solutions of nucleic acid components. Copies of several articles previously published in journals are also included. Most of the experimental work reported was performed by the pulse radiolysis technique employing the 17-MeV linac and associated experimental apparatus. The major goal of this research is the elucidation of indirect mechanisms by which ionizing radiation induces chemical transformations in nucleic acid, its components, and related compounds, and in aminothiols and radiation sensitizing agents. NSA

N71-17493# Idaho Nuclear Corp., Idaho Falls.
ELECTRON GROUND STATES IN MOLECULAR AND VALENCE-BONDED CRYSTALS
H. L. McMurry Oct. 1970 21 p refs
(Contract AT(10-1)-1230)
(IN-1420) Avail: NTIS

This work is a first step toward calculating the potential functions which govern crystal vibrations from a fundamental understanding of how the ground state electronic energy changes when internuclear distances depart from their equilibrium values. The motivation arises from the need to calculate the slow neutron scattering of crystalline moderators (graphite, Be, BeO, etc.). To calculate the frequencies and normal modes, the changes in potential energy with departures of internuclear distances from equilibrium must be known. These potential functions are usually obtained by empirical or semi-empirical processes in which parameters in assumed models are adjusted so calculated frequencies agree with available experimental data. However, experimental data on crystal vibrations have increased to the point where potential functions with sound physical bases are becoming necessary in order to get good agreement between theory and experiment. Author (NSA)

N71-17494# Northwestern Univ., Evanston, Ill.
RADIATION EFFECTS OF ION BOMBARDMENT Final Report, 15 Jun. 1968–31 Aug. 1970
R. L. Hines 9 Oct. 1970 7 p refs
(Contract AT(11-1)-1053)
(COO-1053-15) Avail: NTIS

Research was conducted on the use of positive-ion bombardment to simulate fast-neutron bombardment. Some papers resulting from the research are listed. NSA

N71-17495# Northwestern Univ., Evanston, Ill.
[RELATIONSHIP BETWEEN ION IMPACTS AND CLUSTERS IN GOLD CRYSTAL FOILS] Final Progress Report, 15 Jun. 1969–31 Aug. 1970
R. L. Hines Aug. 1970 3 p refs
(Contract AT(11-1)-1053)
(COO-1053-14) Avail: NTIS

Imperfection clusters produced by Xe-131 ion impacts in Au crystals were studied using weak-beam images in electron microscopy. No structure is observed at low energies, but above 15 keV, pairs or triplets of closely spaced subclusters appear. From the cluster size distribution, the cluster diameter was found to be mainly 10 to 60 A. The ratio of clusters to ion impacts increases with energy above 2 keV, reaching a limiting value of unity near 20 keV. Theoretical calculations of the weak beam contrast for a prismatic dislocation loop on a 111 plane agree with experiment. NSA

N71-17513# Illinois Univ., Urbana.
KAON(+)PROTON ELASTIC SCATTERING AT 2.53, 2.76, AND 3.20 GeV/c
J. Whitmore, G. S. Abrams, L. Eisenstein, J. Kim, T. A. O'Halloran, Jr. et al Aug. 1970 49 p refs
(Contract AT(11-1)-1195)
(COO-1195-196) Avail: NTIS

K(+)p elastic scattering was studied at incident kaon momenta of 2.53, 2.76 and 3.20 GeV/c in the Argonne 30-in. hydrogen bubble chamber. Differential cross sections are presented for all

scattering angles including the backward direction where anomalous behavior is observed in the magnitude and slope of the backward peak in this momentum interval. The forward and backward peaks are compared with Regge models and with previously published data. Results are presented of a partial wave analysis performed at 2.5 GeV/c. While the results are consistent with previous partial wave analyses at lower energies, the data cannot establish the existence of a resonance in the K(+)p system. Author (NSA)

N71-17514*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATED PRESSURE-INDUCED VIBRATIONAL ABSORPTION IN H2-H2 COLLISIONS IN HYDROGEN GAS
R. W. Patch Washington Feb. 1971 41 p refs
(NASA-TN-D-6155; E-5843) Avail: NTIS CSCL 20H

The coefficient for pressure-induced vibrational absorption in H2 - H2 collisions was calculated for temperatures from 298 to 7000 K for transitions with a net change of +1 vibrational quanta. The absorption occurs principally in the infrared. The model included many refinements. The integrated absorption coefficient at 298 K was 87 percent of the experimental value. The integrated absorption coefficient at 3000 K was 2.1 times the previous theoretical value. For pressures from 100 to 1000 atm the Planck and Rosseland mean opacities were increased by factors as high as 18.9 and 303, respectively, over previous estimates. An approximate formula for the spectral absorption coefficient is given for rapid calculation for temperatures from 600 to 7000 K. Author

N71-17515# Washington Univ., Seattle.
ENERGY DEPENDENCE OF QUASIFREE SCATTERING IN THE D(p,pn)p REACTION
W. J. Braithwaite, J. R. Calarco, J. M. Cameron, and Derek W. Storm [1970] 20 p refs Supported in part by AEC
(RLO-1388-126) Avail: NTIS

The cross section was measured for the reaction H-2(p,pn)H-1 at 14, 17, 20, and 23 MeV incident energies. The proton and neutron counter angles were chosen to emphasize the quasifree p-n scattering process. The neutron counter efficiency was measured in order to obtain the absolute differential cross sections. The experimental results agree well with a modified simple impulse approximation, which is discussed. Author (NSA)

N71-17529# Rockefeller Univ., New York.
WEAK INTERACTIONS AT HIGH ENERGIES
A. Pais [1970] 56 p refs
(Contract AT(30-1)-4204)
(NYO-4204-3) Avail: NTIS

A review of high-energy neutrino beam semi-leptonic interactions is presented. Elastic form factor determinations from differential cross sections and polarization effects, total cross sections including sum rules and scaling, and problems beyond the quasi-two-body approximation are considered. NSA

N71-17530# National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.
SELECTED TABLES OF ATOMIC SPECTRA. ATOMIC ENERGY LEVELS AND MULTIPLET TABLES, C(I), C(II), C(III), C(IV), C(V), C(VI)
Charlotte E. Moore Nov. 1970 68 p refs
(NSRDS-NBS-3) Avail: SOD $1.00

Tables of atomic energy level and multiplet data as derived from analyses of optical spectra are presented for all six carbon species. Author

N71-17534# Argonne National Lab., Ill. Applied Physics Div.
SOME IMPROVEMENTS IN VARIATIONAL FLUX SYNTHESIS METHODS
William L. Woodruff May 1970 132 p refs
(Contract W-31-109-eng-38)
(ANL-7696) Avail: NTIS

Three synthesis models are proposed which reflect a consistent application of the semidirect method of the calculus of variations and the various suggested improvements. Although the emphasis is on flux synthesis in space-time neutron diffusion theory, the concepts and methods can be applied to any diffusion or transport problem. The methods can also be applied to static flux synthesis problems. A brief introduction to the calculus of variations in areas relevant to the flux synthesis problem is provided. The neutron diffusion theory problem is presented, and the basic continuous variational formulation is discussed. Some of the early work with discontinuous models for space synthesis is reviewed. The time and space-time models are discussed. Consideration of external boundary conditions and the inclusion of delayed neutrons are analyzed. Author (NSA)

N71-17542# California Univ., Berkeley. Lawrence Radiation Lab.
SEARCH FOR SUPERHEAVY ELEMENTS IN NATURE BY DETECTION OF EVENTS WITH LARGE NUMBERS OF NEUTRONS
E. Cheifetz, E. R. Giusti, H. R. Bowman, R. C. Jared, J. B. Hunter et al Aug. 1970 14 p refs Presented at the Conf. on the Properties of Nuclei far from the Region of Beta Stability, Leysin, Switz., 31 Aug.–4 Sep. 1970
(Contract W-7405-eng-48)
(UCRL-19957; Conf-700815-3) Avail: NTIS

Preliminary results are reported on a search for the presence of superheavy elements in nature. Large samples (10 t 50 kg) of a various substances including W and Pb ores as well as manganese nodules were examined for the presence of spontaneous fission events in which large numbers of neutrons are emitted. The method utilized a large Gd loaded liquid scintillator with 60 to 70% efficiency for detecting neutrons. The system was located in a tunnel of depth approximately 275 meters in order to reduce interference from cosmic rays. In the materials tested, no events above background were detected. This limit corresponds to half lives in the region 10 to the 23 power years relative to the principal component of the samples. Author (NSA)

N71-17543# Hawaii Univ., Honolulu.
MULTIBODY PHOTOPRODUCTION AT NAL
D. Yount 1970 6 p refs Sponsored by AEC
(UH-511-81-70) Avail: NTIS

The possibility of performing multibody photoproduction experiments at NAL is reviewed. Author (NSA)

N71-17544# Pittsburgh Univ., Pa. Dept. of Physics.
RENORMALIZATION, DIAGRAMS, AND GAUGE INVARIANCE
I. Bialynicki-Birula Aug. 1970 36 p refs Prepared in cooperation with Warsaw Univ.
(Contract AT(30-1)-3829)
(NYO-3829-55) Avail: NTIS

A compact formula for the renormalized transition probability in quantum electrodynamics is derived and its interpretation in terms of the diagrams is given. This formula is used next to prove the equivalence of the Coulomb gauge and the Feynman gauge. It is shown that, contrary to the widespread belief, the problem of the gauge invariance becomes a very delicate one when the radiative corrections are included. The common practice of dropping k sub mu and k sub mu terms in the photon propagator D sub mu and nu (k) is justified, but the justification requires a nontrivial analysis of the gauge transformations of the propagators involved. Author (NSA)

N71-17547# Wisconsin Univ., Madison. Dept. of Physics.
DETECTION OF THE WEAK INTERMEDIATE BOSON THROUGH ITS HADRONIC DECAY MODES
D. Cline, A. K. Mann (Pa. Univ., Philadelphia), and C. Rubbia (Harvard Univ.) 6 Jul. 1970 11 p refs Sponsored by AEC
(NYO-2171-323) Avail: NTIS

It is shown that the hadronic decay modes of the weak intermediate boson W produced by high energy neutrinos provide a unique and unambiguous experimental signal of the production and decay of the W, even in the absence of any information about the number, the configuration or the moments of the decay products. This method of detecting the hadronic decay modes of the W, in conjunction with previously utilized methods for detecting the leptonic decay modes, should allow a search for the W to be made which is independent of any assumptions about the hadronic to leptonic branching ratio of the W. Author (NSA)

N71-17548# Oak Ridge National Lab., Tenn. Neutron Physics Div.
V NEUTRON ELASTIC- AND INELASTIC-SCATTERING CROSS SECTIONS FROM 4.19 TO 8.56 MeV
F. G. Perey and W. E. Kinney Oct. 1970 80 p refs
(Contract W-7405-eng-26)
(ORNL-4551) Avail: NTIS

Numerical values for neutron elastic-scattering cross sections for natural V(99.76%V-51, 0.24%V-50) and cross sections per atom of natural V for inelastic scattering to levels in V-51 for incident neutron energies from 4.19 to 8.56 MeV are presented. The data are in good agreement with the results of others. The ENDF/B V elastic angular distributions are in good agreement with experimental data at forward angles but are displaced about 10 deg toward 0 deg beyond the first minimum. The ENDF/B excitation functions are in good agreement with experiment although the inelastic functions stop at 2.6 MeV. The data partially fill priority 3 requests to NCSAC. Author (NSA)

N71-17549# Oak Ridge National Lab., Tenn. Electronuclear Div.
RADIATIVE CAPTURE OF DEUTERONS BY PROTONS AT 20 AND 30 MeV
Bobby Dean Belt (Ph.D. Thesis—Tenn. Univ.) Nov. 1970 130 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3168) Avail: NTIS

The energy spectrum of the He-3 particles from the radiative capture of deuterons by protons has been measured using 19.8- and 29.6-MeV deuteron beams. Precise gamma-ray angular distributions, which cover the entire angular range (0 deg-180 deg), were constructed from the data for both energies and were fitted by the least-squares method to functions of the gamma-ray angle obtained from a multipole expansion of the electromagnetic field. It was found that terms usually retained in this expansion, i.e., M1, E1, E2 and E1/E2 interference, could not account for all the observed features. The addition of terms higher than quadropole removed some of the discrepancy. In addition, the total cross sections were determined to + or −4% accuracy. They were found to be about 10% below recent calculations. Author (NSA)

N71-17550# Washington Univ., St. Louis, Mo. Dept. of Chemistry.
STRUCTURE OF Cr-51 VIA Ti-48(He-4,n gamma) AND V-51(p,n gamma) PROMPT gamma RAY SPECTROMETRY
Demetrios G. Sarantites and Willard G. Winn [1970] 74 p refs
(Contracts AT(11-1)-1530; AT(11-1)-1760)
(COO-1530-21) Avail: NTIS

The level structure of Cr-51 has been studied in some detail via prompt gamma-ray energy and intensity measurements utilizing a NaI(Tl)-Ge(Li) anticompton spectrometer and a 511-gamma-511 escape peak spectrometer via the (V-51)(p,n gamma) reaction with proton energies in the range 2.6-6.0 MeV and via the (Ti-48)(He-4,n gamma) reaction with He-4(++) energies in the range 12.0-15.0 MeV. Many of the gamma-rays associated with levels in Cr-51 were identified with the (He-4,ngamma) or the (p,n gamma) reaction by means of n-gamma coincidence measurements employing an organic phosphor as the fast neutron detector and a Ge(Li) gamma-ray detector. Characterization of many levels populated in the (p,n gamma) reaction was achieved by means of thresholds for individual gamma-rays obtained from measurement of excitation functions of individual gamma-rays and from the gamma-gamma coincidence relationships established in on-beam gamma-gamma coincidence measurements in the (V-51)(p,n gamma) reaction. Author (NSA)

N71-17551# South Carolina Univ., Columbia. Dept. of Physics.
DIRECTIONAL CORRELATION AND INTENSITY STUDIES OF ELECTROMAGNETIC TRANSITIONS IN Te 181
F. T. Avignone, III J. H. Trueblood, and Z. W. Grabowski (Purdue Univ.) [1970] 28 p refs
(COO-1746-46) Avail: NTIS

Gamma-gamma directional correlations have been measured in Te-181 using a 25 cc Ge(Li) detector and a NaI(Tl) detector. Extra-nuclear perturbations were avoided by dissolving the Hf-181 source in a solution of HF. The E2 internal conversion particle parameters for the 133 keV transition were determined by measuring the 133K − 482gamma, the 133 LM −482gamma and the 133gamma − 482gamma correlations in the same solid source. The results are b sub 2(133K) = 1.79 + or − 0.11 and b sub 2(133 LM) − 1.18 + or − 0.10 which are in good agreement with theory. The directional correlation data imply E2/M1 multipole mixing ratios. This value for sigma(482) and a weighted average of the present and four previous values of alpha sub K(482) were used to re-evaluate the internal conversion penetration parameter. Author (NSA)

N71-17584*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ION-CURRENT RESPONSE OF LANGMUIR PROBES IN THE PRESENCE OF ION-ATOM COLLISIONS
Edward P. Szuszczewicz Jan. 1971 13 p refs
(NASA-TM-X-65445; X-625-71-34) Avail: NTIS CSCL 20H

A previous analysis of the Langmuir probe experiments is extended to present a more quantitative description of the effects of ion-atom collisions on the ion saturation current of a probe characteristic. The experiments were conducted with cylindrical probes of length-to-diameter ratios in the range $30 < L/d < 120$. The probes were studied in a weakly ionized argon plasma. The experimental results show that the ion-saturation current is an increasing function of the ratio of the ion-atom mean free path to the probe radius. The level at a ratio value of 4 approximately equals 50% of that which is observed in the collision-free limit, and the absolute collision-free behavior is not achieved until the ratio is approximately 400. A comparison of experimental results with approximate theoretical analysis shows good agreement. Author

N71-17595# Tennessee Univ., Knoxville.
STUDY OF THE NUCLEI Cu 61, Cu 64, Ga 67, AND Ga 68 USING THE (p,n) REACTION
William Thomas Bass (Ph.D. Thesis) Aug. 1970 85 p refs Supported in part by ORNL and Oak Ridge Assoc. Univ.
(TID-25503) Avail: NTIS

Neutron time-of-flight techniques were used to study the (p,n) reaction on the nuclei Ni-61, Ni-64, Zn-67, and Zn-68. The locations of excited states in the residual nuclei up to 3 MeV excitation energy were measured with about 10 keV energy resolution. Some 20 to 70 excited states were identified in the

residual nuclei. Level energies were assigned with certainties of 2 keV for low-lying states and 5 to 7 keV for higher (2 to 3 MeV) states. In general the (p,n) cross sections do not exhibit a strong dependence on the properties of the residual state. However, a certain quantization of the observed peak areas was found. This feature led to a study of the predicted cross sections for final states of different spins and parities using an evaporation mechanism. The method was more sensitive to the spin of the residual nucleus than to final parity. Therefore, in general, only spin predictions were attempted. Spins were assigned to 10 to 20 levels in Cu-64, Ga-67, and Ga-68. The results were in good agreement with known data.
Author (NSA)

N71-17596# California Univ., Berkeley. Lawrence Radiation Lab.
DENSITY OF ELECTRONIC STATES IN ALPHA-PHASE In ALLOYS CONTAINING Cd AND Sn
Norman E. Phillips, J. C. F. Brock (Witwatersrand Univ., Johannesburg, South Africa), Marcel H. Lambert (Univ. Libre de Bruxelles, Brussels, Belgium), and M. F. Merriam Sep. 1970 6 p refs Presented at the 12th Intern. Conf. on Low Temp. Phys., Kyoto
(Contract W-7405-eng-48)
(UCRL-19681; CONF-700921-1) Avail: NTIS

Low-temperature heat capacity measurements on alpha-phase indium alloys were used to obtain the Debye characteristic temperature, the density of electron states, and the electron–phonon coupling constant. The results show further evidence for Brillouin zone boundary–Fermi surface interactions, and are discussed from this point of view. Author (NSA)

N71-17607# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
CALCULATION OF RELATIVE REACTION RATES IN INTERACTING CYLINDRICAL CELLS
Hugh K. Clark Sep. 1970 43 p refs
(Contract AT(07-2)-1)
(DP-1238) Avail: NTIS

A computer program, written in FORTRAN 4, is described for calculating relative reaction rates in reactors composed of interacting cylindrical cells of different types, and the input requirements are listed. The program, INCYCE, permits intracell transport of neutrons to be calculated either from collision probabilities or from the assumption of a cosine distribution for the currents at all interfaces. Intercell transfer of neutrons is calculated on the basis of the assumption that the current entering or leaving a cell has a cosine distribution and that the current leaving a cell is uniform. Comparison is made with some critical experiments. The agreement in terms of buckling and ratios of thermal neutron densities is fairly good. Author (NSA)

N71-17608# Los Alamos Scientific Lab., N.Mex.
PHOXE: A FORTRAN 4 CODE TO CHECK FORMAT SYNTAX, CONSISTENCY, AND PHYSICAL REALISM OF ENDF/B PHOTON PRODUCTION DATA
Donald J. Dudziak Sep. 1970 68 p refs
(Contract W-7405-eng-36)
(LA-4506) Avail: NTIS

Suspected errors are flagged on an output listing immediately after the record in which they are detected. Some preprocessing of the data is performed, both for error checking and for listing convenient quantities (e.g., average photon energy of a continuum) useful to a reviewer. An attempt was made to include any reasonable check capable of being automated and which does not require an interactive capability with systems external to ENDF/B (e.g., a reviewer or data bank). The code is operational on CDC 6600 and IBM 360 computers. Author (NSA)

N71-17635# Kansas Univ., Lawrence. Nuclear Structure Lab.
INTERMEDIATE COUPLING IN THE N = 29 AND Z = 29 NUCLEI
D. Larner 1970 54 p refs
(Contract AT(11-1)-1120)
(COO-1120-106) Avail: NTIS

Levels are calculated for the N = 29 and Z = 29 nuclei, Ti-51, Cr-53, Fe-55, Cu-61,63,65. The model used is the intermediate coupling model, with quasi-vibrational core. A pattern search routine is used to fit the five parameters to the levels and stripping strengths. Except for the case of Cr-53, levels and strengths are fit fairly well. In particular in Fe-55, the states at 1.917 MeV and 2.051 MeV as $3/2(-)$ and $1/2(-)$ states are identified. B(E2) values for transitions to the ground state are calculated, and the comparison with data for Cu-63 and Cu-65 shows good agreement. However, there is no experimental B(E2) data available for the other nuclei. Author (NSA)

N71-17776# California Univ., Livermore. Lawrence Radiation Lab.
CLUSTERING AND GIANT MOMENTS IN Cu-Ni ALLOYS
J. Jach, R. J. Borg (State Univ. of N.Y., Stony Brook) and D. Y. F. Lai 13 Nov. 1970 11 p refs Presented at the 16th Ann. Conf. on Magnetism and Magnetic Mater., Miami, Fla., 17–20 Nov. 1970 Sponsored by AEC Revised
(UCRL-72587-Rev-1; CONF-701104-2-Rev-1) Avail: NTIS

There are several studies of paramagnetic susceptibility and neutron diffraction revealing the presence of giant moments associated with chemical clustering. However, in contrast to the paramagnetic state, there are but few analogous studies extending below Tc. Alloys of about 50-50 cu-Ni composition were prepared as Mossbauer sources containing Co-57. Internal fields, Tc, and isomer shifts were determined as functions of composition and heat treatment. The temperature dependence of the hyperfine spectrum changes very little as a result of annealing at low temperature. Nevertheless, the value of Tc itself dramatically increases in response to clustering, and the isomer shift and internal field near 0 K are significantly altered in response to the change in chemical short-range order. Author

N71-17777# Brookhaven National Lab., Upton, N.Y.
LIMITING TRANSITION FROM NONRELATIVISTIC QUANTUM MECHANICS TO CLASSICAL MECHANICS
V. N. Streltsov Jun. 1970 13 p refs Transl. into ENGLISH from Russian report JINR-P2-4944 Sponsored by AEC
(BNL-tr-354) Avail: NTIS

The limiting transition associated with the direct transition to the classical Hamilton-Jacobi equation is investigated. The relationship between the given limiting transition and another limiting transition which is a corollary of the Ehrenfest theorem is then determined. To do so, the equivalence condition for the system of equations of motion corresponding to these two cases is considered. It is also shown that certain new conditions supporting the given limiting transitions can be introduced. Using the harmonic oscillator as an example, it is determined when the established and the new conditions are violated and, in particular, it is shown that one of the conditions, which supports the limiting transition on the basis of the Ehrenfest theorems, cannot, in principle, hold in this case. Author

N71-17927# National Accelerator Lab., Batavia, Ill.
THE 1969 SUMMER STUDY. VOLUME 4: EXPERIMENTS
Arthur Roberts, ed. 1969 324 p refs
(TID-25473-Vol-4) Avail: NTIS HC$6.00/MF$0.95

Papers are presented in the general areas of two body interactions, small angle scattering, electron-muon experiments, electromagnetic experiments, W (and other vector boson) search experiments, neutrino experiments (other than 25-foot chamber), and related experiments. For Vol. 1, see N71-17049; for Vol. 2, N71-16256; and for Vol. 3, N71-17048. N.E.N.

N71-17941# Los Alamos Scientific Lab., N.Mex.
TWENTY-FIVE GROUP CROSS SECTIONS USED IN THE LOS ALAMOS ROVER PROGRAM
Joseph Sapir Jul. 1970 93 p refs
(Contract W-7405-eng-36)
(LA-4484) Avail: NTIS

The most recent 25 energy-group cross sections used in the neutronic analyses of Rover reactors are presented. Author (NSA)

N71-17942# California Univ., San Diego. Dept. of Physics.
APPLICATION OF COMPRESSIONAL COOLING TO THE STUDY OF NUCLEAR ORDERING IN SOLID HE-3
R. T. Johnson 1969 165 p refs
(Contract AT(11-1)-34)
(UCSD-34-P-143-23) Avail: NTIS

A powerful cooling technique for He-3 was used to observe ordering of the nuclear spins in solid He-3. The He-3 atoms in the solid are localized at lattice sites. Interactions between neighboring atoms are relatively small until temperatures in the low millidegree Kelvin (mK) range are reached. Liquid He-3 is a Farmi liquid and nuclear spins in the liquid begin ordering at much higher temperatures. In the region between 0.5 mK and 0.32 K the solid has a higher entropy than the liquid and isentropic conversion of liquid to solid He-3 will produce cooling. Starting at temperatures above 20 mK, cooling to below 3 mK was obtained. At the lower end of this temperature range, appreciable ordering of the nuclear spins in the solid was observed. A flexible walled cell was developed for compressing a liquid-solid mixture of He-3 at temperatures below the minimum in the melting curve. The cell was precooled to about 20 mK using a continuous dilution refrigerator. Compression was accomplished using liquid He-4 as a pressurizing fluid. The solid entropy was determined using the Clapeyron equation for a first order phase transition. Author

N71-17943# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
NUCLEAR ORIENTATION STUDIES OF LOCAL MOMENTS IN NOBLE METAL HOSTS
R. J. Holliday and W. Weyhmann Sep. 1970 62 p refs
(Contract AT(11-1)-1569)
(COO-1569-67) Avail: NTIS

The internal magnetic fields of Co nuclei as a very dilute impurity in Au, Cu, and a series of Au-Cu alloys were determined by low temperature nuclear orientation of Co-60. The thermometer used was Mn-54 in Cu. A straight line fitted to all the data gives the value of the total magnetic field H(int) in terms of the external applied field H(app) for Au, AuCu, and Cu. If the intercept of the straight lines fit only to the high H(app) points is forced to go through to zero, the value of H(int)/H(app) varies smoothly as the host changes from Au to Cu through a series of Au-Cu alloys. Author

N71-17944# Iowa State Univ. of Science and Technology, Ames.
NUCLEAR MAGNETIC RESONANCE DETERMINATION OF THE ACTIVATION VOLUME FOR SELF-DIFFUSION IN ALUMINUM
Ralph Duane Engardt (Ph.D. Thesis) Nov. 1970 100 p refs
(Contract W-7405-eng-82)
(IS-T-410) Avail: NTIS

The spin-echo technique of nuclear magnetic resonance was used to measure the activation volume for self diffusion in aluminum metal in the temperature range 400 to 450 C. Measurements were made of the inverse linewidth or phase-memory time T2 at hydrostatic pressure up to 3000 atmospheres in the temperature range cited above. It was determined from the temperature dependence of T2 that a temperature-independent relaxation mechanism, equal to 870/sec, contributed to the total observed relaxation rate. This process appears to be a quadrupole interaction with the electric field gradients of dislocation lines. After subtraction of this contribution, the dipolar contribution was found to depend on temperature in accordance with theory, yielding an activation energy for self diffusion of 1.3 + or − 0.2 eV, in good agreement with previous determinations. Author

N71-18009# Idaho Nuclear Corp., Idaho Falls.
APPLICATION OF SOLBRIG'S CELL-DIPOLE METHOD TO MOLECULAR CRYSTALS
H. L. McMurry Oct. 1970 13 p refs
(Contract AT(10-1)-1230)
(IN-1410) Avail: NTIS

In molecular crystals, the intermolecular forces are stronger than the intramolecular forces. It is assumed that as the individual molecules vibrate, dipole moments are produced. The dipoles on any one molecule interact with those on all others causing a change in potential energy. In addition, each molecule is further polarized by the action of the electrical field from the dipoles on all other molecules and this adds an additional contribution to the potential energy. The theory for molecular crystals is presented and makes use of recent ideas for expressing molecular potential functions in terms of coordinates for the groups composing the molecules. The coordinates possess the group symmetry and the potential functions expressed should be amenable to theoretical interpretation in terms of changes in ground state electron energies. Author

N71-18010*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Physics.
MEASUREMENTS OF TRANSITION PROBABILITIES IN SOME MIDDLE WEIGHT NUCLEI
Richard Andrew Kuebbing (Ph.D. Thesis) Jan. 1970 61 p refs
Sponsored in part by NASA and AEC
(NASA-CR-116429; TID-25540) Avail: NTIS CSCL 20H

The level schemes of Nb-92 and Nb-94 were studied by the (p,n) reaction on separated zirconium targets. The pulsed beam of the ORNL 6-MeV Van de Graaff was used to measure the lifetimes of excited states of these nuclei. The 140.4-keV state in Nb-94 was found to have a half-life of (36.8 + or − 0.4) nanoseconds by measuring the decay of the 99.4-keV gamma ray after the production of the state by the pulsed beam. The 226-keV state in Nb-92 was found to have a half-life of (5.2 + or − 0.7) microseconds by measuring the decay of the 90.7-keV gamma ray in the same manner. The spins and parities of these states imply that they should be E1 transitions. A simple explanation of this hindrance is proposed by invoking the shell model. A study of the decay of Br-80 to levels of Kr-80 was made to test the phonon character of the 0(+) excited state of Kr-80. A search was made for the decay of this state by E0 conversion electron as predicted by Reiner. The energy spectrum of electrons from this source in coincidence with other radiations was measured, but no peak was seen. Methods for increasing the sensitivity of the experiment are discussed. Author (NSA)

N71-18043# Harry Diamond Labs., Washington, D.C.
OPTICAL SPECTRUM OF TRIPLY IONIZED ERBIUM IN CALCIUM TUNGSTATE
Donald E. Wortman Jun. 1970 22 p refs
(AD-715008; HDL-TR-1510) Avail: NTIS CSCL 7/4

The energy levels of the quadruplet I ground term of Er(3+) in single crystals of CaWO4 were established by absorption and fluorescence spectra measurements. The measurements were made using crystals at temperatures of 2, 20, and 85K. The energy level scheme allows an interpretation of the 1.612-micron four-level CaWO4:Er(3+) laser transition and shows the terminal energy level of this transition to be 318/cm above the ground state rather than 375/cm as reported by Kiss and Duncan. An effective Hamiltonian of the form suggested by Karayianis was diagonalized on the basis

of Russell-Saunders wave functions to obtain the calculated energy levels and wave functions for the entire ground term of Er(3+). The calculation takes into account the complete J-mixing of the states within the ground term and is equivalent to determining the effects of the spin-orbit interaction to better than second order. Author (GRA)

N71-18044# Oak Ridge Associated Universities, Tenn. Special Training Div.

PROCEEDINGS OF THE SECOND OAK RIDGE CONFERENCE ON THE USE OF SMALL ACCELERATORS FOR TEACHING AND RESEARCH

Jerome L. Duggan, ed. [1970] 466 p refs Conf. held at Oak Ridge, Tenn., 23 -25 Mar. 1970

(DWR-1556; CONF-700322) Avail: NTIS HC$6.00/MF$0.95

Papers are presented in the following general areas: educational uses of small accelerators, solid state physics, activation analysis, atomic physics and astrophysics, biological applications of neutrons and health physics, and general topics. N.E.N.

N71-18050*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.

SPECTROGRAPHIC STUDIES OF LUMINESCENCE IN CHARGED-PARTICLE-IRRADIATED OPTICAL MATERIALS

John Romanko, R. H. McDaniel, J. K. Miles, P. R. Cheever, and G. S. Massingill 21 Mar. 1969 152 p refs

(Contract NAS1-7734)

(NASA-CR-66758; FZK-364) Avail: NTIS CSCL 20H

An experimental investigation was conducted to determine the luminescence induced in optical glasses and quartzes by high-energy charged particles. Spectral luminescence was measured in the wavelength range from 300 to 650 nanometers at a resolution of 0.5 nm utilizing a grating spectrograph. Electron irradiations were performed at six energies from 1 to 20 MeV and proton irradiations at 1, 2, and 3 MeV. Induced luminescence from the specimens varied from a few tenths to approximately 100 nanowatts/sq cm-steradian-nanometer in the visible region. The luminescence of quartzes was found to be linear with flux and absorbed dose of 1, 2, and 3 MeV electrons. Luminescence induced by comparable proton irradiation was nonlinear with flux and absorbed dose, probably due to heating effects. Line spectra characteristics of excited silicon, sodium, and calcium were observed in electron-irradiated Solex. Molecular bands of N2 and N2(+) were observed in experiments performed in air. Transmission measurements were made on a number of pulsed-electron-irradiated glasses in the visible and infrared wavelength regions. Author

N71-18086# European Space Research Inst., Frascati (Italy).

ABSORPTION SPECTRUM OF NaI IN THE VACUUM ULTRAVIOLET

J. P. Connerade, W. R. S. Garton (Imp. Coll.), and M. W. D. Mansfield (Imp. Coll.) Sep. 1970 26 p refs Submitted for publication Supported in part by Roy. Soc., London Univ., and Sci. Res. Council

(ESRIN-IN-101) Avail: NTIS

The absorption spectrum of sodium vapor in the 150 to 600 A region was photographed for the first time. At least 38 discrete features were measured all due to excitation from the 2p6 and 2s2 shells. Hartree-Fock calculations confirmed some of the assignments, and the positions of two transitions were compared with the structure of the L 2 and L 3 edges in the soft X-ray absorption spectrum of solid sodium. Author (ESRO)

N71-18121# Lyon Univ. (France). Inst. de Physique Nucleaire.

VISUAL DISPLAY UNIT CONNECTED TO AN ON LINE COMPUTER USED IN NUCLEAR PHYSICS

Guy Gimond (Ph.D. Thesis) 10 Jul. 1970 66 p refs In FRENCH

(LYCEN-7053) Avail: AEC Depository Libraries

The visual display of nuclear physics spectra on a cathode screen was studied to control experiments and allow dialogue between experimenter and computer by an intermediate visual unit when used at the information input. The following points were treated: the use of a computer for acquiring and treating nuclear physics data, the analysis of problems of visual display on a cathode screen, the presentation of a visual display unit connected to a small computer connected to the Lyon synchrocyclotron, a description of the unit, its language, the associated electronics and the programs which were used. NSA

N71-18122# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.

FAST PARTICLE SCATTERING ON COULOMB AND SHORT RANGE POTENTIALS [RASSEYANIE BYSTRYKH CHASTITS NA KULONOVSKOM I KOROTKODEISTVUYUSHCHEM POTENTSIALAKH]

V. I. Savrin 1969 19 p refs In RUSSIAN

(IFVE-STF-69-106) Avail: AEC Depository Libraries

The scattering of fast particles on the potential, which is a sum of Coulomb and short range potentials, is considered. The expressions for the scattering amplitude at small and large angles and Bethe's interferential formula were obtained. Author (NSA)

N71-18123# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

METHOD OF DETERMINING THE ELECTRON AND POSITRON TRACK PARAMETERS TAKING INTO ACCOUNT THE RADIATIVE LOSSES

P. Kerachev 1970 19 p refs In RUSSIAN

Avail: AEC Depository Libraries

(JINR-P1-5357) Avail: AEC Depository Libraries

An algorithm is described for calculation of the electron tracks in a 2-meter propane bubble chamber, taking into account the radiative losses. The results are presented of processing the experimental and generated tracks using the computer with the program composed on the basis of this algorithm. Author (NSA)

N71-18124# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

SOME PROBLEMS OF REALIZATION OF THE ALTERNATING-PHASE FOCUSING PRINCIPLE IN THE ION LINEAR ACCELERATORS

Yu. D. Beznogikh 1970 23 p refs In RUSSIAN

(JINR-P9-5312) Avail: AEC Depository Libraries

The phase- and the radial stability of particles accelerated in the ion linear accelerators with the alternating-phase focusing is considered. Zero periods of acceleration, in which the synchronous phase is equal to + pion/2 and -pion/2, respectively, are introduced pairwise into the accelerating system with step variation of the synchronous phase. As a result in the structure considered both the radial and the phase stabilities of accelerated particles essentially increase. Author (NSA)

N71-18131# Rockefeller Univ., New York.

BJORKEN LIMIT AND THE JIN-MARTIN LOWER BOUND

Khalil M. Bitar (Am. Univ., Beirut, Lebanon) and N. N. Khuri [1970] 61 p refs

(Contract AT(30-1)-4204)

(NYO-4204-5) Avail: NTIS

The restrictions that analyticity, unitarity (positivity), and current conservation place on the asymptotic behavior in q sub 0 at fixed q of the connected, covariant amplitude M(q, fixed q) are investigated; where M is the connected part of the forward amplitude for the scattering of a charged conserved current on a

proton target. The main tool is a theorem of Jin and Martin which was used to give lower bounds for forward amplitudes. The main result is to establish a rigorous lower bound on the contribution of the class-1 intermediate states to the time-time component. The separation of the absorptive part of the amplitude into class-1 and -2 contributions is carried out explicitly through a fully reduced LSZ formula. The class-1 states are the usual s-channel states and the so-called Z-graph states. The class-2 states are those that couple directly to the current, contribute only for timelike q, and are physically quite distinct from the class-1 states. Author (NSA)

N71-18134# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

IRRADIATION DAMAGE FROM PILE NEUTRONS. DETAILED CALCULATIONS ON THE ATOMIC PROCESSES INVOLVED. PROGRAM SOURCE [DOMMAGES D'IRRADIATION SOUS NEUTRONS DE PILE. CALCUL DETAILLE DES SOURCES EN DEPLACEMENTS ATOMIQUES. PROGRAMME SOURCE]

P. Charbry and J. P. Genthon 1969 91 p refs In FRENCH
(CEA-N-1294; DPE/SPE-69-504) Avail: AEC Depository Libraries

The displacements of atoms and various charged particles in materials subjected to neutron irradiation are studied. These displacements may occur as a result of elastic or inelastic collisions, or by nuclear reactions: (n,p), (n,alpha) and (n,gamma). For each of these cases, the energy spectra of the charged particles and the energy given up to the lattice are calculated. The phenomena associated with the slowdown of these charged particles, particularly the ions, are examined. Electronic collisions ionizing the atoms, and nuclear collisions between ions and lattice atoms are distinguished. The mean free path between collisions, the energy given up to the lattice, the energy spectra of the secondaries produced, and the total paths are calculated. The source program used for these calculations is described. Results are obtained for the neutron bombardment of iron and tungsten and for the slowdown of fission products in uranium and iron. Author (NSA)

N71-18136# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.

FAST VARIATION OF HADRONIC AMPLITUDES AND GAMMA-QUANTA BREMSSTRAHLUNG

A. A. Ponomarev 1970 22 p refs In RUSSIAN; ENGLISH summary
(ITEF-764) Avail: AEC Depository Libraries

Gamma-quanta bremsstrahlung is considered in hadronic reactions in the region of fast variation of hadronic amplitudes. The emission from the interaction region is found at the scattering near the resonance and at the high-energy diffraction scattering. The dependence of the radiation amplitude on the virtual properties of the hadronic amplitude is shown. Possible measurements of the off-shell mass effects in radiative scattering at high energies are discussed. Author (NSA)

N71-18137# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

TABLES OF FISSION-PRODUCT GAMMA TRANSITIONS [TABLE DES TRANSITIONS GAMMA DES PRODUITS DE FISSION]

Jean Blachot and Bertrand Barre Jun. 1970 32 p refs In FRENCH
(CEA-N-1290) Avail: AEC Depository Libraries

The first table includes isotopes from Se-81 to Pm-151 with half lives greater than one minute, arranged in order of increasing mass number. The ten main gamma rays and their relative and absolute energies are given. The second table is a classification of gamma rays in order of increasing photon energy. Author (NSA)

N71-18139# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).

PHOTOPRODUCTION OF W-MESON-ELECTRON PAIRS [FOTOROZHDENIE W-MEZONNYKH PAR NA ELEKTRONE]

V. G. Kompaneets 1970 16 p refs In RUSSIAN
(IFVE-SUM-70-2) Avail: AEC Depository Libraries

The analytical expression for the photoproduction cross section of W-meson-electron up to the double integral on invariance variables for the values of the anomalous momentum of meson 0 + or − 1 is obtained. The analysis of the threshold and asymptotic cross section is given. Author (NSA)

N71-18140# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

NEUTRAL VECTOR MESONS PHOTOPRODUCTION PROCESSES IN QUARK MODEL: Su(3)-STRUCTURE OF ELECTROMAGNETIC CURRENT AND RELATIONS BETWEEN THE DIFFERENTIAL CROSS SECTIONS

M. P. Rekalo 1970 16 p refs In RUSSIAN; ENGLISH summary
(ITF-70-41) Avail: AEC Depository Libraries

Different consequences of the quark model for neutral vector meson photoproduction processes are investigated. It is shown that the relations between the differential cross sections of the processes photon + N yields N + V(0) at t = 0 are very sensitive to a relative value of a possible singlet component of the hadron electromagnetic current. Existing experimental data agree well with the hypothesis of the octet nature of the electromagnetic current. It is shown also that the differential cross sections of the processes photon + N yields N + V(0) at t not = 0 may be connected with differential cross sections of different meson-baryon scattering reactions without any additive assumptions about the quark amplitudes (such, for example, as the validity of the definite relations between quark amplitudes or the possibility of neglecting real parts of the elastic meson-baryon scattering amplitudes with respect to their imaginary parts). Author (NSA)

N71-18141# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.

ON QUARKS WITH COMPLEX SPIN [O KVARKAKH S KOMPLEKSNIM SPINSM]

V. I. Roginskii and I. S. Shapiro 1969 20 p refs In RUSSIAN; ENGLISH summary
(ITEF-763) Avail: AEC Depository Libraries

Previously the foundations of quantum kinematics of a system of two particles with complex spins, differing by an integer or a half odd integer number, were formulated. It is shown that it is possible to construct dynamics of such a system; to introduce the Hilbert space of states and the Hamiltonian, to take account of the identity of the particles. A compound model in which elementary particles are thought as consisting of two unobservable complex spin quarks is discussed (the case of spin-1/2 is considered). It is shown that in this model the mass spectrum and properties of particles (for instances, multipole moments and magnetic moments) can prove essentially different from the conventional compound model. Author (NSA)

N71-18142# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

RECONSTITUTION BY CALCULATION OF THE SPECTRA OF GAMMA RAYS EMITTED BY FISSION PRODUCTS [RECONSTITUTION PAR LE CALCUL DE SPECTRES DES gamma EMIS PAR LES PRODUITS DE FISSION]

Bertrand Barre Jun. 1970 94 p refs In FRENCH
(CEA-N-1313) Avail: AEC Depository Libraries

The theoretical reconstitution of the gamma ray spectra fission products for cooling between 1 and 10 to the 8th power seconds after the thermal fission of a U-235 nucleus is presented from calculation of fission product concentrations using the

PEPINLE-BREF code. The CSET program which makes this reconstitution is intended to facilitate the interpretation of experimentally measured spectra. The nuclides mainly responsible for the gamma activity up to 10,000 seconds after a fission are found to be those which have unknown decay processes. Author (NSA)

N71-18144# Centre National de la Recherche Scientifique, Bellevue (France). Lab. des Terres Rares.
CERIUM(III)-SENSITIZED TERBIUM(III) LUMINESCENCE IN THORIUM-ORTHOPHOSPHATE
R. Heindl, V. Guerin, and J. Loriers [1970] 12 p refs Presented at the 8th Rare Earth Conf., Reno, Nev., 19–22 Apr. 1970
(CONF-700403-5) Avail: AEC Depository Libraries

The luminescence of Tb(III)-activated Ce(III)-sensitized thorium orthophosphate under ultraviolet excitation was investigated. While Th(IV) ions are sometimes sensitizers for Ce(III) ions, in the present compound Ce(III) sensitizes the terbium emission. From the optical measurements, it is concluded that an energy transfer from Ce(III) to Tb(III) occurs. The fluorescence emission spectra are much alike those found in isomorphous $CePO_4$:Tb investigations. Author (NSA)

N71-18145# Akademiya Nauk URSR, Kiev. Inst. Theoreticheskoi Fiziki.
CONNECTION OF NEUTRAL VECTOR MESONS PHOTOPRODUCTION ON THE NUCLEI WITH THE PROCESSES OF pion AND K-MESON INTERACTION WITH NUCLEI
M. P. Rekalo 1970 13 p refs In RUSSIAN; ENGLISH summary
(ITF-70-40) Avail: AEC Depository Libraries

The relations between the differential cross sections of the neutral vector mesons photoproduction on nuclei at t = 0 and the total cross sections of pion and K meson interactions with nuclei are found in the quark model. These relations predict then the A dependence of the differential cross sections of the V(0) photoproduction on the nuclei that agrees well with experimental data for the reaction gamma + A yields A + rho meson (0). The vector dominance hypothesis gives the possibility of obtaining the absolute values of dG/dt (gamma d yields d rho meson) that do not contradict existing experimental data. It is shown that the t dependence of the differential cross sections of the processes gamma + d yields d + rho meson(0) and pion + d yields pion + d must be equal. Author (NSA)

N71-18146# Lyon Univ. (France). Inst. de Physique Nucleaire.
THE STUDY OF (ALPHA, 2 ALPHA) REACTIONS WITH LIGHT NUCLEI [ETUDE DES REACTIONS (ALPHA, 2 ALPHA) SUR QUELQUES NOYAUX LEGERS]
Jean-Rene Pizzi (Ph.D. Thesis) Apr. 1970 54 p refs In FRENCH
(LYCEN-7033) Avail: AEC Depository Libraries

The method of calculating the differential cross section for the (alpha, 2alpha) reaction using the impulse approximation is discussed. The associated experimental techniques are described. The quasi-elastic (alpha, 2alpha) scattering by the nuclei of Li-6, Li-7, Be-9, C-12 and O-16 are studied for an incident energy of 55 MeV. The momentum distribution of the cluster in the nuclear targets is determined by two methods; an angular distribution and an energy distribution method. Author (NSA)

N71-18147# Lyon Univ.(France). Inst. de Physique Nucleaire.
STUDY OF THE 81-NEUTRON NUCLEUS OF Nd 141 [CONTRIBUTION A L'ETUDE DU NOYAU A 81 NEUTRONS DE NEODYME 141]
Roger Duffait (Ph.D. Thesis) Jul. 1970 43 p refs In FRENCH
(LYCEN-7051) Avail: AEC Depository Libraries

The nuclear level scheme of Nd-141 was established from a study of the decay of Pm-141 into Nd-141 using gamma ray spectrometry and measurements made on the conversion electron spectra. The level scheme of Nd-141 was in satisfactory agreement with those obtained by other workers from nuclear reactions. The nature of most of the levels was interpreted in terms of the unified model. The Nd-141 nucleus was considered as being of the even-even type (60 protons, 82 neutrons) with a neutron hole. Analogies and differences between schemes for nuclei of odd mass possessing 81 neutrons were studied. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N71-17025# Oak Ridge National Lab., Tenn.
FEASIBILITY STUDY OF A THOMSON SCATTERING MEASUREMENT OF THE POLOIDAL MAGNETIC FIELD IN THE ORMAK 2
M. Murakami, J. F. Clarke, G. G. Kelley, and M. J. Lubin Oct. 1970 30 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3093) Avail: NTIS

The feasibility of Thomson scattering to determine poloidal magnetic field in a Tokamak-type plasma is considered. The 15 deg scattering of the 10.6 micrometer CO_2 laser beam covers important ranges of the plasma parameters. Simple ways to unfold the scattering spectra are discussed. The method appears to be feasible, although it requires sophisticated technology, such as a high-power well-collimated CO_2 laser, a multichannel high-resolution Fabry–Perot interferometer, and low-noise infrared detectors. Author (NSA)

N71-17026# California Univ., Livermore. Lawrence Radiation Lab.
REQUIREMENTS OF RECOVERY EFFICIENCIES FOR MIRROR FUSION POWER SYSTEMS
Warren Heckrotte and John R. Hiskes 20 Aug. 1970 27 p refs Sponsored by AEC
(UCRL-50920) Avail: NTIS

A parametric study of recovery efficiencies for different Q values is presented for a D–T system and for a neutron-free system. The properties of these fusion power systems are discussed with reference to their steady state operation and to their transient operation up to full power level. The partitioning of energy among the plasma constituents is calculated. The energy distributions of the charged components leaving the plasma, especially the electrons, will bear on the design of the direct convertor. Some disucssion is given on the relative merits of a D–T system vs. a D–He system as a means of relaxing the requirements on the recovery efficiencies and circulating power. Author (NSA)

N71-17050# California Univ., Berkeley. Electronics Research Lab.
PLASMA RESEARCH Quarterly Progress Report, 1 Apr.–30 Jun. 1970
30 Jun. 1970 45 p refs
(Contract AT/04-3/-34)
(UCB-34-P-128-16) Avail: NTIS

Numerical simulation of plasmas is discussed. The theory for simulation and verification of the theory for plasma of finite-size particles are described. Computer simulation of plasma heating processes is discussed in some detail. NSA

N71-17058# European Space Research Inst., Frascati (Italy).
THE EFFECT OF ELECTRON ANISOTROPY ON WHISTLERS LEADING STRONG COLLISION-FREE SHOCKS

Karl Schindler and Andre Rogister [1970] 13 p refs Submitted for publication Sponsored in part by Max-Planck Inst. fuer Extraterrestrische Phys.
Avail: NTIS

Using the linear Vlasov theory it is shown that whistlers propagating obliquely to the magnetic field in a homogeneous plasma are unstable if the electron thermal anisotropy is sufficiently large in either direction. Some implications of this effect for whistlers leading strong collision-free shock waves are discussed. The main effect is that in the unstable regime the leading part of the shock does not have the usual (growing) oscillatory structure but a monotonically increasing one (solitary-wave-type edge). Author (ESRO)

N71-17807# Aerospace Corp., El Segundo, Calif. Lab. Operations.
MICROWAVE BREAKDOWN IN THE PRESENCE OF SPATIAL NONUNIFORMITIES: COMPUTER PROGRAMS, AUGUST 1968 –MARCH 1970
Glenn C. Light 30 Sep. 1970 27 p refs
(Contract F04701-70-C-0059)
(AD-715259; TR-0059(6220-10)-4; SAMSO-TR-70-392) Avail: NTIS CSCL 20/9

The conventional theory of microwave breakdown in a uniform electric field is reviewed. Theoretical analyses are presented, on the basis of a variational formulation of Epstein, for continuous wave and for pulsed breakdown in the general case of nonuniform electric field and nonuniform gas properties. The results of computer calculations based on these theoretical analyses are shown. Comparisons are made between these results and exact results in the limit of a uniform field and uniform gas. Comparisons are also made between these results and those of several other investigators for the case of an x-band rectangular slot radiator in a ground plane. Author (GRA)

N71-17816# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.
RELATIVISTIC MOTION OF A SINGLE PARTICLE UNDERGOING CYCLOTRON RESONANCE IN A MAGNETIC MIRROR TRAP
David W. Faulconer Jul. 1970 45 p refs
(Contracts N00014-67-A-0077-0015; AT(30-1)-3782)
(AD-714857; LPS-54) Avail: NTIS CSCL 20/9

The relativistic motion of a single particle undergoing cyclotron resonance in a magnetic mirror trap is studied. The Krylov-Bogoliubov method of averaging is employed to derive equations indicating an upper bound on particle energy. Smallness parameters necessary for the validity of these equations are made explicit. Limitation on particle energy absorption is found for a much broader class of particles than previously known. The relationship of this to experiment is discussed. Author (GRA)

N71-17817# Aerospace Corp., El Segundo, Calif. Lab. Operations.
MEASUREMENT OF THE RF MAGNETIC FIELD DISTRIBUTION IN A THERMAL INDUCTION PLASMA
Hans U. Eckert 30 Oct. 1970 29 p refs
(Contract F04701-70-C-0059)
(AD-715265; TR-0059(9220-02)-2; SAMSO-TR-70-396) Avail: NTIS CSCL 20/9

The radial distribution of the RF magnetic field is measured with a water-cooled search coil of 3-mm diam in the midsection of an argon induction plasma flame maintained at 2.6 MHz in a 150-mm-wide tube. Over most of the flame section, the field is reduced from an unperturbed value of 15 A/cm to 0.5A/cm. The skin depth is about 1 cm. In the annular space between the flame and the inductor coil, the field is increased by 10%. The resultant magnetic pressure gradients may cause a substantial radial flow of plasma toward the axis. The effects of signal averaging, current obstruction, and plasma cooling by the probe are discussed and found to be of minor consequence. Author (GRA)

N71-17819 New Hampshire Univ., Durham.
MHD WAVES IN THE INNER MAGNETOSHEATH
Jiann Tsorng Horng (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-2077

Properties of MHD discon. uities are discussed with emphasis on the magnetic field. Numerical solutions for large amplitude fast and slow simple waves are obtained and plotted in the rho'-B' sub t plane, where rho' is proportional to the particle density and B' sub t is proportional to the transverse magnetic field strength. Models are also proposed to illustrate the magnetic field configuration in the transition region within 1 earth radius of the magnetopause. The wave propagation vector k is calculated by assuming it lies in the direction which minimizes the variance of B · n, where n is a variable unit vector. Magnetic fields observed by Explorer 12 are then projected onto a coordinate system in which k is one axis. Wave polarizations are studied in this projection. Dissert. Abstr.

N71-17823 Stanford Univ., Calif.
WHISTLER PROPAGATION AND INSTABILITY CHARACTERISTICS
Joseph Chen Lee (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-1563

Theoretical and experimental studies of electromagnetic wave propagation in a homogeneous magnetoplasma are presented. The mode of interest is right-hand polarized, propagating parallel to the magnetic field, and is known in ionospheric terminology as the whistler mode. The theory of its propagation is based on a self-consistent solution of the Boltzmann equation with Maxwell's equations. By considering a series of electron velocity distributions, a comprehensive distribution of whistler propagation, damping and instability characteristics has been obtained. For isotropic distributions, it is shown theoretically that whistlers propagating parallel to the magnetic field are always stable, and can only suffer cyclotron (collisionless) damping. Both collisional and collisionless damping have been analyzed and computed. Previous calculations of whistler damping are also discussed. Dissert. Abstr.

N71-17824*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON THE EFFECTS OF MONOENERGETIC ELECTRONS IN A STEADY-STATE, LOW PRESSURE PLASMA
Nelson L. Milder Washington Feb. 1971 40 p refs
(NASA-TN-D-6150; E-5912) Avail: NTIS CSCL 20I

An expansion of the Tonks – Langmuir static free-fall theory of a one-dimensional, beam generated plasma in a plane diode configuration is described. An electron density consisting of a superposition of cathode emitted, collisionally scattered monoenergetic (primary) electrons upon a Maxwellian distribution is considered. Ion production due to both species of electrons is included. Cases are treated in which the primary electron space charge contributes to plasma neutralization as well as ion production. In such cases the potential distribution, ion current density and mean ion energy in the plasma differ from the beam-free case. Special cases of the derived plasma equation are solved. Author

N71-17840# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.
THEORETICAL ANALYSIS OF AN INDUCTIVE, CYLINDRICAL MHD CONVERTER WITH CRYOGENICALLY COOLED WINDINGS [UEBER DIE THEORIE DES INDUKTIVEN ZYLINDERSYMMETRISCHEN MHD-WANDLERS MIT KRYOGEN GEKUEHLTER WICKLUNG]
Andreas Gann Jun. 1970 65 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-25) Avail: NTIS; ZLDI Munich: 17.20 DM

Two dimensional calculations for an infinite length cylindrical converter with a liquid metal incompressible medium and constant channel flow velocity are presented. The effects of eddy-currents induced in the outer channel wall and of the liquid metal viscosity were included. A computer program was developed to evaluate the converter performance. Author (ESRO)

N71-17961# ARC, Inc., Arnold Air Force Station, Tenn.
IONIZATION AND THERMAL NONEQUILIBRIUM IN MHD BOUNDARY LAYERS Final Report, 1 Jul. 1968 –30 Jun. 1969
Donald W. Cott AEDC Nov. 1970 72 p refs
(Contract F40600-71-C-0002)
(AD-715272; ARO-PWT-TR-70-155; AEDC-TR-70-231) Avail: NTIS CSCL 20/9

The effects of thermal nonequilibrium (elevated electron temperature) and ionizational nonequilibrium (finite-rate recombination) are studied in the insulator boundary layer of a potassium-seeded nitrogen MHD accelerator flow. The nonsimilar, compressible boundary layer is assumed steady, laminar, and two-dimensional. A collisionless sheath is assumed and matched with the boundary layer equations, which are solved numerically for a core flow Hall-neutralized Faraday accelerator. The relative importance of the various terms in the electron energy equation are assessed, and the overall effect of the nonequilibrium phenomena on the boundary layer parameters is described. It is concluded that thermal nonequilibrium can lead to significant B-wall shorting in long channels and that Hall effects should not be neglected but that operation is not noticeably affected by ionizational nonequilibrium or the physics of the electrostatic sheath. Author (GRA)

N71-18018# Human Resources Research Organization, Alexandria, Va.
FUNCTIONAL REQUIREMENTS FOR GROUND-BASED TRAINERS: HELICOPTER RESPONSE CHARACTERISTICS
W. G. Matheny and L. E. Wilkerson Oct. 1970 121 p refs
(Contract DAHC19-70-C-0012)
(AD-714954; HUMRRO-TR-70-17) Avail: NTIS CSCL 5/9

The overall research purpose was to develop methods for analyzing the helicopter pilots control tasks, as a basis for deciding characteristics needed in a ground-based trainer for use in pilot training. The report covers one phase, the response characteristics of the helicopter as it reacts to control inputs and external forces. Analyses were made of (a) characteristics of each dimension of control, (b) interaction among the dimensions, (c) effect of external forcing functions such as wind, (d) information the pilot receives by kinesthetic feedback from the controls. A measure of man-machine system characteristics was postulated--the effective-time constant, the time it takes for the displayed output of the system to rise above the pilots threshold of perception. Dealing with the effects of interaction among the controls proved to be one of the most difficult pilot tasks; of the single dimensions, pitch control is the most difficult. The characteristics of the system were identified in such a way that they can be varied quantitatively in research on task difficulty and transfer of training. Author (GRA)

N71-18083# North Carolina State Univ., Raleigh. Dept. of Physics.
PRODUCTION OF DENSE HOT PLASMAS
Willard H. Bennett 15 May 1970 8 p
(Grant AF-AFOSR-1743-69)
(AD-715275; AFOSR-70-2485TR) Avail: NTIS CSCL 20/9

In the first phase of the program the objective is to develop methods for injecting currents of more than one hundred thousand amperes at energies of more than four million electron volts in thirty nanosecond pulses within mean angular divergences of less than one degree and within radii of less than three millimeters through a thin metal foil into the end of magnetically self-focusing discharges in such a manner that the relativistic beam is pinched down to radii of less than one-tenth millimeter. Pinched discharge equipment is under development in the Laboratory. Experiments are going forward in the development of methods for producing in vacuum, controlling and guiding currents in excess of one hundred thousand amperes at voltages in excess of four megavolts in beams less than one millimeter in diameter. These are to be tested for suitability for injection into pinched discharge for further pinching down to the smaller radii. Author (GRA)

N71-18084# Avco-Everett Research Lab., Everett, Mass.
INTERACTION OF A QTX WAVE WITH DENSITY FLUCTUATIONS IN AN INHOMOGENEOUS MAGNETIZED PLASMA
Guy M. Weyl Oct. 1970 17 p refs
(Contract F44620-70-C-0023)
(AD-715277; AERL-RR-361) Avail: NTIS CSCL 20/9

Propagation of a QTX wave through an inhomogeneous magnetized plasma is studied. Modulation of the reflection coefficient of the plasma is predicted due to density fluctuations in the region of evanescence of the wave. A measurement of the modulation is proposed as a diagnostic of certain plasma instabilities. Author (GRA)

N71-18085# Georgia Inst. of Tech., Atlanta.
REPLY TO LONGITUDINAL DIFFUSION COEFFICIENTS MISNAMED BY R. N. VARNEY
I. R. Gatland and E. W. McDaniel Lafayette, Ind. Purdue Univ. Nov. 1970 11 p refs Prepared for Purdue Univ.
(Contract N00014-67-A-0226-0005; Proj. Squid)
(AD-714868; GIT-7-PU) Avail: NTIS CSCL 20/9

Varney has recently applied random walk methods to discuss the longitudinal diffusion of gaseous ions drifting in an electric field, and he obtained results which differ from those obtained by solution of the diffusion equation. Varneys analysis leads him to state that the measured longitudinal diffusion coefficients are not diffusion coefficients at all. Several arguments are presented here to refute Varneys findings. Author (GRA)

N71-18090# Princeton Univ., N.J. Plasma Physics Lab.
A NEW VERSION OF THE DIPOLE EXPANSION SCHEME
B. Rosen (Stevens Inst. of Tech.), W. L. Kruer, and J. M. Dawson Nov. 1970 15 p refs
(Contracts N00014-67-A-0151-0021; AT(30-1)-3785)
(AD-715075; PPL-NP4) Avail: NTIS CSCL 20/9

The report describes a modified version of the dipole expansion technique for particle simulation of plasmas. In this version the field calculations do not take significantly longer than in nearest-grid-point calculations. This is particularly important in two- and three-dimensional simulations. Also discussed is an optimization of the coding, particularly for the operations that must be done for each particle (computing its contribution to the charge density and updating its position and velocity). For example, this optimization has given a one-dimensional, nearest-grid-point code (lowest order in the multipole expansion scheme) that takes about 1.8 microsec/particle on the IBM 360/91. Finally, the value of the dipole correction is determined by comparing dipole and nearest-grid-point simulations. Author (GRA)

N71-18091# Princeton Univ., N.J. Plasma Physics Lab.
ANOMALOUS DAMPING OF LARGE-AMPLITUDE ELECTRON PLASMA OSCILLATIONS
W. L. Kruer and J. M. Dawson Nov. 1970 9 p refs
(Contract N00014-67-A-0151-0021)
(AD-715074; PPL-NP3) Avail: NTIS CSCL 20/9

With computer experiments the authors have investigated

the behavior of large-amplitude, high-phase-velocity plasma oscillations in an electron-ion plasma. The experiments show that such a wave, when above a given threshold amplitude, produces an instability that results in its anomalous damping. The results are in agreement with theory. This is one mechanism by which large-amplitude electrostatic oscillations generated by an instability (for example, by the two-stream instability), can be dissipated. Author (GRA)

N71-18135# Academy of Sciences (USSR), Leningrad.
SOME PECULIARITIES IN PLASMA FORMATION BY MICROWAVE POWER NEAR ELECTRON CYCLOTRON HARMONICS
V. N. Budnikov, K. M. Novik, and A. A. Obukhov 1970 11 p refs In RUSSIAN; ENGLISH summary
(NP-18503) Avail: AEC Depository Libraries

Plasma formation by 3-cm microwave power in a magnetic field is studied. Plasma was created in a quartz tube 70 cm long and with a diameter of 2.5 cm (up to 700 W). The experiments were carried out in argon at pressures from 0.02 to 0.002 mm Hg. The effect of high-frequency plasma spreading along the magnetic field at values corresponding to electron cyclotron harmonics is investigated. The measurements by double probes were made along the tube. Fast electron groups with energy about 100 eV are shown to exist. Their formation is associated with the absorption of incident wave energy in a small volume because of the large absorption coefficient of plasma waves in the vicinity of cyclotron harmonics. Author (NSA)

N71-18148# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
AMBIPOLAR POTENTIAL EFFECTS ON COULOMB SCATTERING INTO THE LOSS CONE
M. Brambilla and F. Werkoff 1970 4 p refs Presented at 4th European Conf. on Controlled Fusion and Plasma Phys., Rome, 31 Aug.–4 Sep. 1970
(CEA-CONF-1609; CONF-700817-7) Avail: AEC Depository Libraries

The Fokker–Planck equation describing Coulomb scattering into the loss cone in the presence of an ambipolar potential is written in a velocity coordinate system in which the loss hyperboloid was a coordinate surface. The equation is numerically solved for the case of ion–ion collisions. Author (NSA)

N71-18149# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Sukumi (USSR). Fiziko-Tekhnicheskii Inst.
STUDIES OF DIFFUSION OF DENSE DECAYING PLASMA IN A STELLARATOR
R. A. Demirkhanov, D. G. Baratov, N. I. Malykh, V. G. Merezhkin, M. A. Stotland et al 1970 14 p refs In RUSSIAN
(NP-18502) Avail: AEC Depository Libraries

Helium plasma decay in a circular two-path stellarator with magnetic field variations from 6 to 12 koe was studied under conditions in which the classical diffusion time is smaller than the Bohm time and the mean free path of electrons is considerably shorter than the system. The plasma density and temperature were about 1×10 to the 14th power/cu cm and 0.6 eV, respectively. It is shown that, taking into account the recombination elimination of charged particles, the plasma confinement time as a function of magnetic field intensity and angle of rotational transform can be determined accurately with the hydrodynamic model of classical plasma diffusion in a toroidal helical magnetic field. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N71-17020# California Univ., Berkeley. Lawrence Radiation Lab.
MICROWAVE PHOTON ASSISTED TUNNELING IN SUPERCONDUCTING TUNNELJUNCTIONS
James Newton Sweet Aug. 1970 116 p refs
(Contract W-7405-eng-48)
(UCRL-19653) Avail: NTIS

An experimental study has been conducted on microwave photon-assisted tunneling in superconducting Sn/I/Sn and Sn/IPb tunnel junctions. The junctions were situated in a perpendicular rf electric field. For quasi-particle tunneling, excellent agreement with the power dependence predicted by the theory of Tien and Gordon has been obtained for junctions with large normal-state resistances. The response of low-resistance junctions has been found to agree well with the predictions of a phenomenological lumped-circuit junction model, which includes the effects of junction capacitance. The effective rf voltage seen by the quasi-particle current is, however, an order of magnitude greater than that which is estimated to be present from rf power measurements. The interaction of microwaves with Josephson currents was studied for the same junctions and the response compared to the theoretical predictions of Werthamer. Author (NSA)

N71-17021# Cornell Univ., Ithaca, N.Y. Dept. of Applied Physics.
FLUCTUATIONS NEAR THE PHASE TRANSITION IN ONE-DIMENSIONAL SUPERCONDUCTORS
R. J. Warburton and W. W. Webb 21 Sep. 1970 31 p refs Presented at the Battele Colloq. on Critical Phenomena, Geneva, Sep. 1970 Sponsored by AEC
(NYO-3029-45; CONF-700918-1; Rept-1455) Avail: NTIS

The effects of thermodynamic fluctuations on the superconducting order parameter can be observed readily near the critical temperature if the fluctuation volume is restricted by reducing the physical dimensions of the system. A comparison is made between several competing theories that predict the effect of fluctuations on the temperature dependence of the electrical resistivity near the transition temperature. Measurements of the complete resistive transition of one-dimensional single crystals of tin wire extended through the critical region down to 0.00001 ohms and the current–voltage characteristics were extended to a sensitivity of ten to the minus 15th power volts in order to thoroughly test these theories. Author (NSA)

N71-17022# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
SUPERCONDUCTIVITY IN THE PSEUDOBINARY ALLOYS V3Si-NbAl
L. R. Newkirk and C. C. Tsuei Oct. 1970 8 p refs
(Contract AT(04-2)-822)
(CALT-822-13) Avail: NTIS

The compounds Nb4Al and V3Si were found to be mutually soluble. The superconducting transition temperature and the lattice spacings were measured over the entire range of the pseudobinary system. The lattice parameter varied smoothly with composition, and the variation of the superconducting transition temperature exhibited a deep minimum centered near the middle of the pseudobinary. This behavior was interpreted in terms of phonon propagation along the face-centered chains of atoms in the A15 structure, and the effect of foreign atoms on this propagation. Author (NSA)

N71-17023# Illinois Univ., Urbana.
ELECTRON IRRADIATION EFFECTS IN SILICON AT LIQUID HELIUM TEMPERATURES USING ac HOPPING CONDUCTIVITY
R. E. McKeighen and J. S. Koehler Aug. 1970 16 p refs Presented at Intern. Conf. on Radiation Effects and Semiconductors, Albany, N.Y., 24–27 Aug. 1970

(Contract AT(11-1)-1198)
(COO-1198-744; CONF-700824-1) Avail: NTIS

Changes in ac hopping conductivity with electron irradiation were measured in n-type, p-type, and high purity silicon. Irradiations were carried out at both 4.8 and 1.6 K, with measurements made at reference temperatures of 4.2 and 1.3 K, respectively. In the p-type crystals, the changes in ac hopping conductivity depended strongly on the concentration of chemical acceptors, indicating a concentration dependence on impurities in the defect production rate. The production rates at 1.6 K were generally very similar to those for a 4.8 K irradiation. A small amount of reverse annealing, i.e., an increase in ac hopping conductivity, was observed below 30 K. No radiation annealing effects due to a beam of either 0.500- or 0.350-MeV electrons were observed, either at 4.5 or at 1.45 K. Author (NSA)

N71-17024*# Purdue Univ., Lafayette, Ind. Dept. of Physics.
STUDIES OF NICKELOUS AND COBALTOUS OXIDE AND EFFECTS OF n-TYPE AND p-TYPE DOPANTS
William Rives Helms (Ph.D. Thesis) [1970] 95 p refs Supported in part by NASA and GE
(Contract AT(11-1)-1616)
(NASA-CR-116435; COO-AT(11-1)-1616-14) Avail: NTIS

Mossbauer, chemical, and X-ray studies establish that the low temperature preparations of cobaltous and nickelous oxide have significant structural differences from high temperature preparations. The low temperature stoichiometric preparations, CoO(II) and NiO(II), are viewed as sponge-like structures, with a large concentration of dispersed anion and cation vacancies. Schottky defects appear to be responsible for most of the observed differences between high and low temperature forms. Experiments in which NiO and CoO are doped with Li, Cr, and Ga have shown that significant changes in the ratio Fe(2+)/Fe(3+) are obtained. Li doping enhances the Fe(3+) resonance, while Cr and Ga enhance the Fe(2+) resonance. The qualitative effects of the dopants are explained using a band model for these semiconducting oxides. Author

N71-17175 Lincoln Lab., Mass. Inst. of Tech., Lexington.
ISOMORPHIC SUBSTITUTION OF 2Ca(2+) YIELDS Ln(3+) + Na IN GARNETS [IZOMORFNOYE ZAMESHCHENIYE 2CA(2+) YIELDS LN(3+) + NA V GRANATAKH]
B. V. Mill et al May 1970 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorg. Mater. (USSR), v. 5, no. 10, 1969 p 1776-1779
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Substitution of 2Ca(2+) yields Ln(3+) + M(+) (Ln = rare earth elements and yttrium; M = K, Na) is widely used for optical activation of various oxide compounds; however, for garnets it is unknown. Optical activation for garnets such as Ca3, M2(3+) M3(4+) O12, where M(3+) = Fe(3+), Ga(3+), Cr(3+); M(4+) = Ge(4+), Si(4+) is discussed. The starting components for preparing the mixtures were Na2CO3, CaCO3, the oxides M2O3, MO2 and Ln2O3 no less than 99.5 percent pure. The batch was pressed into disks and annealed in air at various temperatures in a range from 900 to 1300 C for a period of 8-12 hours. The products of sintering were investigated radiographically for phase composition (URS-50 IM diffractometer, SI-4R counter, radiation Cu K sub alpha and Co K sub alpha). The lattice constant of the garnets aO was determined from the reflections, located in the region of the angles theta = 60 - 82.5 degrees with subsequent extrapolation to theta = 90 deg for cos squared theta. Author

N71-17176# Rice Univ., Houston, Tex. Dept. of Chemistry.
MICROWAVE SPECTRUM OF GeF2
H. Takeo, R. F. Curl, Jr., and P. W. Wilson [1970] 27 p refs Sponsored in part by AROD
(Grant NSF GP-6305)
Avail: Issuing Activity

The microwave spectrum of germanium difluoride has been observed and assigned in the ground (0,0,0), the three first excited, and the (0,2,0) vibrational states. The equilibrium structure of GeF2 is r sub e = 1.7321 angstroms and alpha sub e = 97 deg. 10 minutes. The dipole moment of GeF2 has been determined to be 2.68 debye by measurement of the Stark effect. The harmonic force constants have been obtained by combining the inertial defects of the vibrational states with previously reported vibrational frequencies. These force constants are f sub r = 4.08, f sub alpha = 0.31 sub 6, f sub r = 0.26, f sub r alpha = -0.01 millidynes/angstrom. The cubic force constants have been obtained from the changes in the rotational constants with vibrational state. Author

N71-17177# Naval Research Lab., Washington, D.C.
THE ELASTIC CONSTANTS FOR SINGLE-CRYSTAL BISMUTH FROM ROOM TEMPERATURE TO THE MELTING POINT
E. W. Kammer, L. C. Cardinal, C. L. Vold, and M. E. Glicksman Dec. 1970 48 p refs
Avail: NTIS

The complex behavior of metals under severe thermal and stress environments is influenced markedly by their elastic properties. Indeed, the response of a material to an applied stress or to an increase in temperature when under stress is always determined, in part, by the elastic constants and their temperature coefficients. Furthermore, both the mechanical and thermodynamic equations of state of a metal that contains dislocations require detailed knowledge of the single-crystal elastic constants for calculations of elastic free-energy densities and of plasticity response on a microstructural scale. These particular measurements developed as an ancillary part of a larger program dealing with the determination of solid-liquid interfacial free energies in metals. That program required, among other data, the isothermal elastic compliances of the crystal lattice of pure bismuth at the melting point. One effective way to acquire values for the elastic compliances is the determine first a complete set of their inverse elastic stiffness constants. The elastic stiffness constants can be determined from observations of the velocity of ultrasonic waves in single-crystal specimens of the metal; a routine mathematical conversion then yields the required compliances. Since the constants determined from the ultrasonic pulse-echo technique are characterized as adiabatic, a small thermodynamic correction is added to convert the matrix of adiabatic compliances to a matrix of isothermal compliances. Author

N71-17178*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
DEBYE-SCHERRER INVESTIGATIONS OF EXPERIMENTALLY SHOCKED SILICATES
Friedrich Hoerz (Lunar Sci. Inst., Houston, Tex.) and William L. Quaide [1970] 85 p refs *Its* Lunar Sci. Inst. Contrib. No. 02
(Grant NGR-05-002-105)
(NASA-TM-X-66703) Avail: NTIS CSCL 20L

Small ballistic ranges were used to perform controlled laboratory shock experiments on 12 selected silicates [quartz (30-310 kb), oligoclase (30-340 kb), andesine (40-100 kb), olvine (80-500 kb), forsterite (50-150 kb), enstatite (60-150 kb), biotite (10-90 kb), hornblende (50-150 kb), garnet (40-160 kb), kunzite (60-150 kb), beryl (60-140 kb), topaz (60-150 kb)]. At least 4 pressure points per mineral are available. Debye-Scherrer investigations of shocked materials revealed a gradual lattice breakdown of crystalline matter under shock. Individual mineral species behave selectively. Sheet silicates break down very easily, followed by tecto silicates. Chain-, ino- and ortho-silicates are of considerably higher shock resistance. Depending on the mineral species, the first sign of shock damage is evidenced in the long range order at 20-70 kb. Author

N71-17231# Cornell Univ., Ithaca, N.Y. Materials Science Center.
PRESSURE AND TEMPERATURE DEPENDENCE OF THE ELASTIC CONSTANTS OF RbCl RbBr, AND RbI
M. Ghafelehbashi (Ph.D. Thesis) Jan. 1970 133 p refs
(Contract AT(30-1)-2504)
(NYO-2504-69; Rept-1291) Avail: NTIS

Ultrasonic measurements of the elastic constants of RbCl, RbBr, and RbI as a function of pressure up to approximately 4 Kbars in the temperature range of 120 deg to 300 K have been made. The reduction of the raw data is analyzed according to a self-consistent method and is discussed at length so as to clarify the limitations as well as the precision of the final results. The results of adiabatic as well as the isothermal values of the elastic constant measurements at pressure are given together. The rubidium salts undergo a phase transformation from NaCl structure, face center cubic, to CsCl structure, body centered cubic, at the pressure of few Kbars. The exact mechanism of the transformation is not known. Author

N71-17232# California Univ., Berkeley. Lawrence Radiation Lab.
PRECIPITATION IN HIGH PURITY SILICON SINGLE CRYSTALS
Aasmund Erik Nes (Ph.D. Thesis) Aug. 1970 86 p refs
(Contract W-7405-ENG-48)
(UCRL-19608) Avail: NTIS

Precipitation in high purity, Lopex (low oxygen, dislocation free), silicon has been examined by x-ray diffraction topography and transmission electron microscopy. It has been found that the impurity concentration in the as-grown silicon crystals is sufficient to cause precipitation of a second phase if the specimens are annealed in the temperature range 700 to 1000 C, followed by a critical cooling rate. The precipitating phase has been tentatively identified as alpha-Fe3Si. The precipitates appear in colonies. Each colony has a three dimensional star like configuration, where the different arms are planar arrangements of precipitates enveloped by a dislocation loop. The nucleation of colonies is heterogeneous in nature and the presence of small silica particles as nucleation centers is suggested. The critical cooling rate effect is explained in terms of a vacancy condensation mechanism. Author

N71-17276# National Bureau of Standards, Washington, D.C. Inst. for Applied Technology.
SILICON DEVICE PROCESSING
Charles P. Marsden, ed. Nov. 1970 469 p refs Symp. held at Gaithersburg, Md., 2–3 Jun. 1970; sponsored in part by Am. Soc. for Testing and Mater.
(NBS-SP-337) Avail: SOD $5.50

The results of a symposium on silicon device processing are reported. The most advanced methods of process control and materials characterization are discussed and the interdependence of measurement techniques, facilities, and materials is stressed with respect to the problems of improving silicon device sciences and technologies. For individual titles see N71-17277 through N71-17318.

N71-17277# Bell Telephone Labs., Inc., Murray Hill, N.J.
SOME THOUGHTS ON HOW WE MIGHT IMPROVE OUR MATERIALS AND PROCESS WORK
D. C. Thomas *In* NBS Silicon Device Process. Nov. 1970 p 3–10 (See N71-17276 07-26)
Avail: SOD $5.50

The techniques used to improve the quality of silicon processing are discussed and the reasons for improving the quality are given. The main considerations are to increase the size of an individual integrated circuit chip up to a maximum size and to reduce the cost per chip with increased yields. Improvement in quality results in lower design tolerances and permits finer lines and lower capacities. R.B.

N71-17278# International Business Machines Corp., Hopewell Junction, N.Y. East Fishkill Lab.
CRYSTALLOGRAPHIC IMPERFECTIONS AS RELATED TO SILICON CRYSTAL GROWTH
J. A. Lenard *In* NBS Silicon Device Process. Nov. 1970 p 11–18 refs (See N71-17276 07-26)
Avail: SOD $5.50

Problems of growing silicon crystals while keeping crystallographic imperfections to a minimum are described, with emphasis on Czochralski-grown crystals. The increase in silicon crystal diameter is attributed to improved analytical techniques for assessing the structure of crystals produced in a given system. Among these techniques are X-ray diffraction microscopy and the scanning oscillator technique. Since growth-rate fluctuations are the major cause of nonhomogeneous impurity distributions, thermal gradient variations, and crystal diameter changes, it is necessary to obtain tighter control of the growth conditions. Use of the IBM 1800 process control computer to grow silicon crystals of uniform diameter and superior structure is briefly described. Author

N71-17279# Mullard Research Labs., Redhill (England).
EPITAXIAL GROWTH OF SILICON
B. A. Joyce *In* NBS Silicon Device Process. Nov. 1970 p 19–20 ref (See N71-17276 07-26)
Avail: SOD $5.50

The fundamental aspects of growing epitaxial silicon films are discussed and their relationship to practical device processing technology is considered. The material is presented under five topic headings: (1) growth systems, (2) nucleation and growth mechanisms, including substrate surface effects, (3) crystallographic defects, (4) dopant incorporation and redistributions, and (5) deposition on insulating substrates. Author

N71-17280# Bell Telephone Labs., Inc., Murray Hill, N.J.
DIFFUSION IN SILICON: PROPERTIES AND TECHNIQUES
C. F. Gibbon *In* NBS Silicon Device Process. Nov. 1970 p 21–35 refs (See N71-17276 07-26)
Avail: SOD $5.50

Fundamental concepts of the kinetics of diffusion in solids are presented and the mathematics of diffusion for the generally utilized approximations is outlined. The physical interpretation of the diffusion coefficient and its potential dependence on concentration are discussed. Features of the chemistry of a number of diffusion sources such as high temperature trihalide depositions, predeposited doped SiO2 films, and doped silicon in vacuo are described. A brief review of diffusion coefficient data for the common dopants in silicon and SiO2 is presented. Consideration is given to the various mechanisms which have been proposed for the diffusion of dopants in silicon. Author

N71-17281# Fairchild Camera and Instrument Corp., Palo Alto, Calif. Research and Development Lab.
MEASUREMENT AND CONTROL OF DIELECTRIC FILM PROPERTIES DURING SEMICONDUCTOR DEVICE PROCESSING
Bruce E. Deal *In* NBS Silicon Device Process. Nov. 1970 p 36–50 refs (See N71-17276 07-26)
Avail: SOD $5.50

The methods for measuring and controlling chemical, physical, and electrical properties of the various types of dielectric films during the fabrication of semiconductor devices are reviewed. Measurement and control procedures for both thermal oxide and combination dielectric films, as well as control procedures for processing materials, are summarized. Electrical properties of dielectric films have been found to be the most significant in regard to resulting device characteristics, and the MIS capacitance-voltage technique is shown to be very effective for monitoring and controlling these properties. Observations are made of the current

status of dielectric films in semiconductor technology and of requirements they must satisfy in the future. Author

N71-17282# Hugle Industries, Inc., Sunnyvale, Calif.
EQUIPMENT CONSIDERATIONS FOR SILICON EPITAXIAL REACTORS
M. L. Hammond and W. P. Cox *In* NBS Silicon Device Process. Nov. 1970 p 51–59 refs (See N71-17276 07-26)
Avail: SOD $5.50

The subsystems of a batch silicon epitaxy reactor (power supply, cabinetry, reactor geometry, gas flow control, and automatic control) are discussed. The effect of reaction chamber geometry on reactor performance is reviewed and fully automated epitaxial reactors using closed loop automatic gas flow control are described. Author

N71-17283# Fairchild Camera and Instrument Corp., Palo Alto, Calif. Research and Development Lab.
A COMPARISON OF A RESISTANCE-HEATED REACTOR FOR SILICON EPITAXIAL GROWTH WITH OTHER EPITAXIAL SYSTEMS
Willem A. Kohler *In* NBS Silicon Device Process. Nov. 1970 p 60–65 refs (See N71-17276 07-26)
Avail: SOD $5.50

A special reactor was developed for growing epitaxial silicon films in a resistance-heated system. The reactor is designed to minimize the deposition of silicon on the tube walls, thus eliminating the major disadvantage of resistance-heated systems. The construction of the reactor is described, and its advantages and disadvantages compared to other approaches. Author

N71-17284# General Telephone and Electronics Labs., Inc., Woburn, Mass.
TECHNIQUES FOR DEPOSITING HIGHLY UNIFORM AND DEFECT-FREE EPITAXIAL SILICON
Dinesh C. Gupta and John L. Porter (Sylvania Elec. Prod., Inc., Woburn, Mass.) *In* NBS Silicon Device Process. Nov. 1970 p 66–78 refs (See N71-17276 07-26)
Avail: SOD $5.50

Techniques for producing silicon epitaxial layers with uniform thickness and resistivity control and high surface quality are discussed. Among the topics considered are low temperature deposition, the effects of gas velocity on deposition and on impurity distribution in the layer, and deposition of the layers using a mixture of silane and silicon tetrachloride. R.B.

N71-17285# Radio Corp. of America, Princeton, N.J.
CONTROL OF THIN SILICON FILMS GROWN FROM SILANE
D. J. Dumin *In* NBS Silicon Device Process. Nov. 1970 p 79–86 refs (See N71-17276 07-26)
Avail: SOD $5.50

The electrical properties of thin films of silicon grown epitaxially on sapphire or spinel can be controlled to a considerable extent by control of the growth parameters. Unlike the case of homoepitaxial silicon growth, the electrical properties of heteroepitaxial silicon can be considerably altered by relatively small variations in the growth conditions. The variations in growth rates and growth temperatures combined with variations in the carrier ambient and purity of the source gases, makes analysis of the growth-dependent, electrical properties complicated. Several aspects of the characterization of the electrical properties of the silicon films are discussed. Particular attention is given to the effects of variations in growth temperature, growth rate, film thickness, and defect structure in the thin silicon films. Author

N71-17286# Bell Telephone Labs., Inc., Murray Hill, N.J.
THE GROWTH OF SUBMICRON SINGLE AND MULTILAYER SILICON EPITAXY
J. Simpson, A. C. Adams, and M. H. Hanes *In* NBS Silicon Device Process. Nov. 1970 p 87–98 refs (See N71-17276 07-26)
Avail: SOD $5.50

The growth of submicron single and multiple epitaxial silicon layers deposited by the silane pyrolysis method was studied. The structural and electrical properties of such layers are discussed in relation to the silicon deposition parameters and to the substrate surfaces. The silane decomposition process was examined from 950 to 1150 C and the ability to control reproducibly both thin film uniformity and thickness is shown to be strongly dependent on the linearity of the process parameters studied. The problems associated with the characterization of substrate surfaces and epitaxial layers are discussed in terms of the techniques used to measure surface cleanliness and the thickness and distribution of impurity atoms in epitaxial layers. Author

N71-17287# Bell Telephone Labs., Inc., Murray Hill, N.J.
TECHNIQUES FOR DETERMINING SURFACE CONCENTRATION OF DIFFUSANTS
J. C. Irvin *In* NBS Silicon Device Process. Nov. 1970 p 99–110 refs (See N71-17276 07-26)
Avail: SOD $5.50

Eight techniques for the determination of the surface concentration, Cs, of diffused layers in silicon are reviewed. The techniques are: (1) use of published curves relating junction depth and sheet resistance to Cs, (2) use of published curves relating Cs to measured Hall effect, (3) differential sheet resistance due to removal of a surface lamina, (4) differential radioactive analysis, (5) differential Hall effect, (6) the spreading resistance probe, (7) plasma resonance, and (8) ratio of maximum and minimum capacitances of a MIS capacitor. The limitations and range of application of each method are discussed. Author

N71-17288# International Business Machines Corp., Hopewell Junction, N.Y. East Fishkill Facility.
CURRENT STATUS OF THE SPREADING RESISTANCE PROBE AND ITS APPLICATION
T. H. Yeh *In* NBS Silicon Device Process. Nov. 1970 p 111–122 refs (See N71-17276 07-26)
Avail: SOD $5.50

Calculations of the correction factors for spreading-resistance probe measurements made on N-N(+)-P structure, based on the multilayer step-junction theory and utilization of a computer, is presented. An iteration scheme is also adopted in the process of obtaining the correction factor, and the corrected resistivity, for each measured value. A figure of corrected impurity profile vs depth is plotted out by the computer automatically. The use of the spreading resistance probe to obtain the impurity profiles for the diffused structures of N-P or p-n, based on the multilayer step-junction theory and the utilization of a computer for the calculation of the correction factors, is discussed. Author

N71-17289# Research Triangle Inst., Durham, N.C.
INCREMENTAL SHEET RESISTIVITY TECHNIQUE FOR DETERMINING DIFFUSION PROFILES
R. P. Donovan and R. A. Evans *In* NBS Silicon Device Process. Nov. 1970 p 123–131 refs (See N71-17276 07-26)
Avail: SOD $5.50

Measurements of incremental sheet resistivity are discussed for determining impurity distribution following diffusion. The measurements require no special apparatus or equipment not commonly found in a semiconductor laboratory and employ procedures that silicon technologists are familiar with. The method consists of measuring the sheet resistivity of the diffused layer,

removing a thin uniform increment from the surface, remeasuring the sheet resistivity and repeating the procedure until the desired depth is reached. The success of the method depends upon the ability to accurately measure sheet resistivity of the wafer or sample and uniformly remove a measurable increment of silicon from the surface. Uncertainties in the method exist because of the assumption that carrier mobility in the thin increments removed is the same as the carrier mobility measured in bulk samples. For many diffused layers this assumption is valid. When the assumption is questionable, the sheet resistivity measurements can be easily supplemented by measurements of sheet Hall coefficient. Incremental measurements of sheet resistivity and Hall coefficient together yield profiles of both carrier concentration and mobility and are valuable in evaluating the influence of annealing upon the electrical properties of ion implanted layers. Author

N71-17291# Stanford Univ., Calif. Electronics Labs.
USE OF HIGH ENERGY ION BEAMS FOR THE ANALYSIS OF DOPED SURFACE LAYERS
S. Chou, L. A. Davidson, and J. F. Gibbons *In* NBS Silicon Device Process. Nov. 1970 p 141–155 refs (See N71-17276 07-26)
Avail: SOD $5.50

By monitoring the backscattered ions, X-rays, or other radiation emitted by the semiconductor during ion bombardment, it is possible to determine the impurity concentration. The dependence of radiation yield on the direction of incidence of the ion beam gives information regarding the crystalline order of the sample, as well as the lattice locations of impurities. The interpretation of elastic ion-backscattering data is emphasized. Experimental results on arsenic-doped silicon are presented as an illustration of the technique. Author

N71-17292# Aerospace Corp., El Segundo, Calif.
DETERMINATION OF DIFFUSION COEFFICIENTS IN SILICON AND ACCEPTED VALUES
M. F. Millea *In* NBS Silicon Device Process. Nov. 1970 p 156–167 refs (See N71-17276 07-26)
Avail: SOD $5.50

A generalized definition of atomic migration is developed using the Onsager–Fuoss phenomenological approach and the conditions which must be satisfied when using Fick's first and second laws are discussed. Various diffusion mechanisms are considered to illustrate possible interactions between crystal properties and atomic migration, with special attention given to the effect of short-range solute-enhanced heavy doping and induced space-charge regions on diffusion. The effect of short-range solute-enhanced migration is also considered in discussing the effect of heavy doping on self-diffusion in silicon. The techniques commonly employed to determine atomic movement in silicon are presented; random and possible systematic errors are considered. The experimentally determined diffusion coefficients for Group 3A, 4A and 5A elements are examined and accepted diffusion coefficients for these elements in intrinsic silicon are proposed. Experimental studies of the effects of heavy doping on the self-diffusion and migration of tin, phosphorus, arsenic, antimony, and indium are discussed. Author

N71-17293# Radio Corp. of America, Sommerville, N.J. Solid State Div.
DIFFUSION TECHNOLOGY FOR ADVANCED MICROELECTRONICS PROCESSING
W. Greig, K. Cunniff, H. Hyman, and S. Muller *In* NBS Silicon Device Process. Nov. 1970 p 168–174 ref (See N71-17276 07-26)
Avail: SOD $5.50

The development of phosphorus diffusion for forming emitters in n-p-n structures is reviewed chronologically to illustrate the process optimization that has occurred not only as a result of process evaluation but from a consideration of device requirements such as electrical properties, performance, and yield. Both the phosphorus pentoxide system and the phosphorus oxychloride system are discussed in detail. Author

N71-17294# Fairchild Camera and Instrument Corp., Palo Alto, Calif. Research and Development Lab.
DIFFUSION FROM DOPED-OXIDE SOURCES
M. L. Barry *In* NBS Silicon Device Process. Nov. 1970 p 175–181 refs (See N71-17276 07-26)
Avail: SOD $5.50

Diffusion into silicon from low-temperature deposited doped oxides is discussed with respect to other diffusion technologies. Various processes used for deposition of doped oxides and their diffusion characteristics are reviewed. The advantages claimed for doped oxide sources are compared to those of standard gas-phase predeposition-diffusion techniques. Author

N71-17295# Bell Telephone Labs., Inc., Murray Hill, N.J.
CAPACITANCE: A DEVICE PARAMETER AND TOOL FOR MEASURING DOPING PROFILES
B. R. Chawla *In* NBS Silicon Device Process. Nov. 1970 p 182–183 refs (See N71-17276 07-26)
Avail: SOD $5.50

The technique for measuring doping profiles using capacitance-voltage measurements is based on the classical C square-root V law for a step junction. An automatic implementation of this technique for plotting inverse of doping versus distance was reported previously. The limitations and present results which increase the range of application of the capacitance-voltage technique are discussed. The applicability of the square-root law is limited to junctions where the doping on one side of the junction is much greater than that on the other side. The normal usage of this technique lies in the range of reverse bias which restricts the knowledge of the doping profile away from the junction. Using an alternative definition for the transition region capacitance (not including the diffusion capacitance), calculation shows that it remains finite and that an equivalent parallel plate capacitor in which the position of the plate is well marked is feasible. Further limitations of the C square-root V law arise when a region of higher doping density than the one near the surface, e.g., the interface between a lightly doped epitaxial layer on a highly doped surface, is probed by the C-V technique. Author

N71-17296# Rensselaer Polytechnic Inst., Troy, N.Y.
CONCENTRATION DEPENDENT DIFFUSION PHENOMENA
P. E. Bakeman, Jr. (Rensselaer Res. Corp.) and J. M. Borrego *In* NBS Silicon Device Process. Nov. 1970 p 184–191 refs (See N71-17276 07-26)
Avail: SOD $5.50

The experimental work and associated theoretical explanations for concentration-dependent diffusion phenomena are reviewed, including field aided diffusion, strain enhanced diffusion, electronic vacancy diffusion effects, and experimental measurement techniques. A theory which treats concentration dependent diffusion phenomena from a fundamental point of view is presented. The theory is based on a simple assumption for impurity atom interaction in diffusion systems which exhibit solid solubility saturation. The theory yields a self-consistent result for the diffusion coefficient and chemical potential as a function of impurity concentration. The theoretically predicted diffusion coefficient is: $D' = D(Cmax + C)/(Cmax - C)$, where D is the low level diffusion coefficient, C is the impurity concentration, and Cmax is the saturation impurity concentration. The theory is compared with available experimental data on the diffusion of phosphorus in silicon. Author

N71-17297# Bell Telephone Labs., Inc., Allentown, Pa.
ORIENTATION DEPENDENT DIFFUSION PHENOMENA
L. E. Katz *In* NBS Silicon Device Process. Nov. 1970 p 192–201 refs (See N71-17276 07-26)
Avail: SOD $5.50

The present knowledge and parameters associated with orientation dependent diffusion in silicon are reviewed and analyzed. Particular emphasis is placed on the orientation dependence of boron in silicon. It has been experimentally observed that the diffusion of boron in (100) is greater than in (111) under oxidizing and perhaps other ambients. Concentration profiles of the diffusion of boron in silicon were calculated to determine the parameters which are responsible for the enhanced diffusion. The parameters investigated were segregation coefficient, oxide growth rate constant, and diffusion coefficient. These parameters were individually varied in the diffusion equation in order to observe their effect on the concentration profile and the junction depth. The problem of orientation dependence is also analyzed on the basis of work hardening theory considering vacancy generation via dislocation. It is concluded that any enhanced diffusion based on this mechanism would be expected to occur at high concentration and would result in more enhancement for diffusion in the (111) direction in comparison with the (100) direction. Author

N71-17298# International Business Machines Corp., Essex Junction, Vt. Components Div.
DIFFUSION-INDUCED DEFECTS AND DIFFUSION KINETICS IN SILICON
S. Dash and M. L. Joshi *In* NBS Silicon Device Process. Nov. 1970 p 202–222 refs (See N71-17276 07-26)
Avail: SOD $5.50

Diffusion of phosphorus and boron is known to introduce plastic deformation in the form of misfit dislocations in silicon. Studies show that the initial stage of diffusion-induced plastic deformation is associated with generation of sessile dislocation loops of interstitial nature. Misfit dislocation nets are formed through interaction of these loops during diffusion. Phosphorus impurity profiles in silicon are observed to follow ideal distribution functions in the absence of dislocations, even when surface concentration Cs of phosphorus reaches the solid solubility limit. Deviation of both impurity profiles and dislocation generation depend upon the critical value of integrated doping of phosphorus and not upon the value of Cs alone. Arsenic diffusion also introduces sessile dislocation loops of interstitial nature. Introduction of interstitial loops during diffusion lends support to the theory that diffusion in silicon takes place via extended interstitials and not via single or double vacancies. Author

N71-17299# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Research Labs.
ON THE INTERPRETATION OF SOME MEASUREMENT METHODS FOR EPITAXIALLY GROWN LAYERS
P. J. Severin *In* NBS Silicon Device Process. Nov. 1970 p 224–233 refs (See N71-17276 07-26)
Avail: SOD $5.50

The thickness of epitaxially grown layers is commonly measured by infrared multiple reflection. It has been proposed to apply a correction for the phase shift at the layer-substrate interface as a function of wavelength. By direct calculation from measured spectra, a phase shift independent of the wavelength was found. The layer-substrate reflection coefficient, generally assumed to be constant, is verified to vary exponentially with the wave number, yielding another constant phase shift. The measured constant phase shift cannot be explained from this dependence. A large number of spectra were analyzed and found to yield a very precise thickness and constant phase shift. The correlation of the measured values to a linear wave number versus integer relationship is typically 0.9998 using the method of least squares with a desk calculator. Various characteristics of a measurement method (accuracy, precision, reproducibility, destructiveness, speed and in-process moment) are elaborated and applied to the four-point probe, spreading resistance, and capacitance-voltage methods. These methods are competitive and complimentary in obtaining the resistivity. Author

N71-17300# International Business Machines Corp., Hopewell Junction, N.Y. East Fishkill Lab.
THICKNESS MEASUREMENT OF VERY THIN EPITAXIAL LAYERS BY INFRARED REFLECTANCE
P. A. Schumann, Jr. *In* NBS Silicon Device Process. Nov. 1970 p 234–243 refs (See N71-17276 07-26)
Avail: SOD $5.50

The development of infrared reflectance for measuring the thickness of a semiconductor epitaxial layer deposited on a substrate of the same conductivity type but of higher impurity concentration is reviewed. Various techniques of interpreting the interference spectra are discussed and their limits of applicability given. It is shown that with recent techniques, measurements can be made on layers as thin as 0.3 micron. Experimental comparisons are presented with bevel, stain, and spreading resistance. A method of interpreting the interference spectra is discussed which enables measurement of both the layer thickness and substrate carrier concentration. It is shown that this may be extended to provide a carrier concentration profile as a function of depth of a portion of the out-diffused region of the epitaxial layer. Author

N71-17301# Westinghouse Research Lab., Pittsburgh, Pa.
SPREADING RESISTANCE MEASUREMENTS ON BURIED LAYERS IN SILICON STRUCTURES
R. G. Mazur *In* NBS Silicon Device Process. Nov. 1970 p 244–255 refs (See N71-17276 07-26)
Avail: SOD $5.50

The uses and limitations of the spreading resistance technique for the evaluation of buried collector layer structures in integrated circuits are discussed. Detailed results are presented on one particular type of structure to illustrate the applicability of spreading resistance measurements to buried layer problems. Author

N71-17302# Bell Telephone Labs., Inc., Murray Hill, N.J.
VARIATIONS OF A BASIC CAPACITANCE-VOLTAGE TECHNIQUE FOR DETERMINATION OF IMPURITY PROFILES IN SEMICONDUCTORS
W. C. Niehaus, W. van Gelder, T. D. Jones, and P. Langer (Western Elec. Co., Inc., Allentown, Pa.) *In* NBS Silicon Device Process. Nov. 1970 p 256–272 refs (See N71-17276 07-26)
Avail: SOD $5.50

Two recently developed variations of the basic C-V technique are presented: (1) pulsed MIS C-V measurements which can be used to measure the impurity profile of a sample covered by a dielectric film, and (2) a second harmonic profiling technique which has the advantages of instantaneous readout and simplicity of operation. Corrections to both the second harmonic and standard C-V profiling techniques are given for the case when the experimental measurements are made on graded p-n junctions. A modification of the standard C-V analysis method is presented which permits the use of capacitance interval sizes up to 95% of the zero bias value. This analysis method eliminates the need to make small capacitance intervals. Specific examples of the four techniques are presented. Author

N71-17303# University of Southern Calif., Los Angeles.
A NEW IMPURITY PROFILE PLOTTER FOR EPITAXY AND DEVICE
B. J. Gordon, H. L. Stover, and R. S. Harp (Calif. Inst. of Tech., Pasadena) *In* NBS Silicon Device Process. Nov. 1970

p 273–284 refs (See N71-17276 07-26)
(Contract AF-AFOSR-1622-69A)
Avail: SOD $5.50

An on-line measuring instrument is described which can measure doping profiles of a finished device or of a material slice. The doping profile (N versus W) is plotted directly onto an X-Y recorder. The instrument can cover a variation of at least three decades of doping on a given sample without changing the settings. The instrument operation is based on simple physics and complex electronics. The key portion of the instrument is a precision automatic capacitance measuring network operating at 1 MHz. A swept dc bias and a controlled ac dither signal are applied to the diode simultaneously, resulting in dc and ac outputs proportional to C and dC/dV respectively from the capacitance measuring network. These signals are then processed by precision analog circuitry to produce outputs of log N and log W after junction area and permittivity are incorporated into the display coordinates. Plots of C versus V are also available from the instrument. Profile data, C, and dC/dV data are presented for several device samples, including well punched-through material and Read diodes. An X-band Read diode profile illustrates the large range of doping measurable.
Author

N71-17304# General Telephone and Electronics Labs., Inc., Woburn, Mass. Waltham Research Center.
STRUCTURAL FAULTS IN EPITAXIAL AND BURIED LAYERS IN SILICON DEVICE FABRICATION
P. Wang, F. X. Pink, and D. C. Gupta *In* NBS Silicon Device Process. Nov. 1970 p 285–301 refs (See N71-17276 07-26)
(Contract F33615-67-C-1508)
Avail: SOD $5.50

Structural defects observed in silicon material in device fabrication, especially after epitaxial layer formation and diffusion, are discussed. The techniques commonly used to detect defects for single crystal silicon are given. The defects are correlated with the yield and performance of the product using a NAND/NOR integrated circuit for demonstration.
Author

N71-17305# Beckman Instruments, Inc., Fullerton, Calif.
AN INSTRUMENT FOR AUTOMATIC MEASUREMENT OF EPITAXIAL LAYER THICKNESS
Allison Roddan and Vitali Vizir (Fairchild Semicond. Corp., Mountain View, Calif.) *In* NBS Silicon Device Process. Nov. 1970 p 302–312 refs (See N71-17276 07-26)
Avail: SOD $5.50

Designed to operate in the production QA environment, the system utilizes the infrared scan method while incorporating an electronic data processor to provide computation, storage, and control functions. The infrared spectrophotometer is optimized for epitaxial measurement. Design parameters and performance requirements are discussed in detail along with several sample and control features. To eliminate operator error from the measurement interpretation and data reduction, all peak picking, thickness calculating, and phase shift correcting tasks are provided by a general purpose data processor. The processor also provides batch storage and hard copy data output printing. The system is designed for a 2% accuracy specification and a 480 sample per hour measurement rate.
Author

N71-17306# International Business Machines Corp., Hopewell Junction, N.Y. Components Div.
DEFECTS INDUCED IN SILICON THROUGH DEVICE PROCESSING
M. L. Joshi and J. K. Howard *In* NBS Silicon Device Process. Nov. 1970 p 313–364 refs (See N71-17276 07-26)
Avail: SOD $5.50

The role of residual strains in creating defects is investigated. Operations on silicon crystal, such as slicing and lapping, introduce damage in crystal structures adjoining the surfaces of the silicon slices. The subsequent polishing operation is expected to remove the damage; the consequences of the failure of this operation to remove the damage are creation of residual strains. Strains of both the plastic and the elastic types are introduced in silicon through diffusion and precipitation of impurities. Diffusion is used for fabrication of structures such as base, emitter, isolation, subcollector, and resistor. Diffusion of both the odd-size atom impurities and the same-size atom impurity, arsenic, introduces plastic deformation in silicon. Effects of the plastic deformation on impurity distributions are also analyzed. Cooperative diffusion effects are discussed in terms of the size of an impurity. The effects of the process steps involving heat-treatment of silicon are examined from the point of view of defect generation in substrate silicon and in various diffused structures.
Author

N71-17307# Westinghouse Electric Corp., Baltimore, Md.
A STUDY RELATING MOS PROCESSES TO A MODEL OF THE Al-Si-O2-Si SYSTEM
Marvin H. White, Franklyn C. Blaha, and David S. Herman *In* NBS Silicon Device Process. Nov. 1970 p 365–374 refs (See N71-17276 07-26)
Avail: SOD $5.50

A model of the Al-SiO2-Si system is presented to aid in the control and understanding of integrated circuit fabrication. The model assumes that ionic contamination is distributed through a thin phosphosilicate glass under the Al electrode. The ionic contamination is composed of alkali and hydronium ions which result from the unit processes. The level and type of ionic contamination is inferred from capacitance-voltage measurements and the interface state density is monitored by capacitance-time measurements. The intrinsic surface-state charge is less than 10 to the 10th power cm in the process sequence described.
Author

N71-17308# Texas Instruments, Inc., Dallas, Tex.
ACTIVATION ANALYSIS IN SILICON DEVICE PROCESSING
Graydon B. Larrabee and H. Gary Carlson *In* NBS Silicon Device Process. Nov. 1970 p 375–383 refs (See N71-17276 07-26)
Avail: SOD $5.50

The application of neutron activation analysis to silicon device processing is discussed. A review of the technique is given and the effects of irradiation conditions, sample handling, and radioassay on the ultimate sensitivity are described. Examples of the introduction of ppm to sub-ppb levels of both dopant and unwanted impurities in device processing steps are given.
Author

N71-17310# Motorola, Inc., Chicago, Ill.
METALLIZATION DEPOSITION PARAMETERS AND THEIR EFFECT ON DEVICE PERFORMANCE
J. R. Black *In* NBS Silicon Device Process. Nov. 1970 p 398–408 refs (See N71-17276 07-26)
Avail: SOD $5.50

Aluminum films used as conductors for semiconductor devices and integrated circuits, and deposited by condensation of the vapor in a vacuum ambient and etched into patterns using lithengraving techniques, are considered. Aluminum film deposition parameters and their effect on film properties are discussed. These film properties as well as conductor design parameters are then related to various factors which can degrade the device properties or lead to device failure.
Author

N71-17311# Wacker-Chemie G.m.b.H., Burghausen (West Germany).
METHODS FOR DETERMINATION OF THE CHARACTERISTICS OF HYPER-PURE SEMICONDUCTOR SILICON AND THEIR INFORMATION CONTENT FOR THE DEVICE PRODUCTION

Fritz G. Vieweg-Gutberlet *In* NBS Silicon Device Process. Nov. 1970 p 409–411 refs (See N71-17276 07-26)
Avail: SOD $5.50

The characterization of bulk silicon as a starting material for semiconductor device production is considered with respect to the information about conductivity type, resistivity, minority carrier lifetime, and crystal perfection. The methods for detection of the resistivity differ from one another in their basic structure and the information content. In the case of the lifetime measurement, the methods and the information content differ between measurements on the starting material and the results obtained by measurements later in the processing of the material, for example, after the first diffusion step. The crystal perfection varies from the starting material due to defects introduced during the different device production steps. The different methods for describing the material and the information obtainable from them are reviewed. Author

N71-17312# Semiconductor Processing Co., Inc., Hingham, Mass.
MECHANICAL DAMAGE: ITS ROLE IN SILICON SURFACE PREPARATION
R. B. Soper *In* NBS Silicon Device Process. Nov. 1970 p 412–418 refs (See N71-17276 07-26)
Avail: SOD $5.50

Silicon is mechanically damaged during the centerless grinding, slicing, lapping and mechanical polishing operations used to shape the ingot into wafers. Surface damage removed by chemical processes and peripheral defects such as conchoidal fractures, indents, and microcracks are discussed. Various polishing methods and how they relate to mechanical damage are compared. Author

N71-17313# Bell Telephone Labs., Inc., Murray Hill, N.J.
CRYSTALLOGRAPHIC DAMAGE TO SILICON BY TYPICAL SLICING, LAPPING, AND POLISHING OPERATIONS
T. M. Buck and R. L. Meek *In* NBS Silicon Device Process. Nov. 1970 p 419–430 refs (See N71-17276 07-26)
Avail: SOD $5.50

Literature on surface damage on silicon resulting from shaping operations such as sawing, lapping, and polishing is surveyed. Topics covered include depths of damage by various processes, techniques for detecting damage, effect of residual damage in high temperature operations, the microscopic nature of abrasion damage, proposed mechanisms of fine polishing operations, a procedure for achieving a smooth, relatively damage-free surface, and recent results of ion scattering experiments on polished surfaces. Author

N71-17314# Radio Corp. of America, Somerville, N.J. Solid State Div.
THE PREPARATION OF PRACTICAL, STABILIZED SURFACES FOR SILICON DEVICE FABRICATION
A. Mayer and D. A. Puotinen *In* NBS Silicon Device Process. Nov. 1970 p 431–435 refs (See N71-17276 07-26)
Avail: SOD $5.50

Methods for chemically treating real surfaces to contain a minimum of oxide impurities are described, together with suitable use tests. The influence of subsurface damage is also examined and methods of detection are discussed. The effect of crystal defects is briefly considered. Author

N71-17315# South Carolina Univ., Columbia, S.C. Coll. of Engineering.
SURFACE CONTAMINATION
J. W. Faust, Jr. *In* NBS Silicon Device Process. Nov. 1970 p 436–441 refs (See N71-17276 07-26)
Avail: SOD $5.50

Techniques and modifications of existing techniques to gain information about impurities and particulate matter in the oxide layer are considered. Some of the techniques mentioned are: transmission electron microscopy, electron microprobe, ellipsometry, selected area diffraction, neutron activation analysis, and radio tracer studies. The techniques show a variety of impurities such as sodium, potassium, and heavy metals. In some cases, particulate matter such as abrasive particles are present. Some suggestions for reducing or eliminating these contaminants are given. Author

N71-17316# International Business Machines Corp., Hopewell Junction, N.Y. East Fishkill Facility.
THE PRECIPITATION OF OXYGEN IN SILICON, AND ITS EFFECT ON SURFACE PERFECTION
William J. Patrick *In* NBS Silicon Device Process. Nov. 1970 p 442–449 refs (See N71-17276 07-26)
Avail: SOD $5.50

The behavior of oxygen in silicon is reviewed and experimental observations on the nature of the precipitated phase and the kinetics of its growth are reported. The defects appear to be related to the surface defects reported to occur during steam oxidation of silicon. The nature of the defects as revealed by metallographic and transmission electron microscopy techniques is discussed. Experimental evidence of their effect upon the perfection of epitaxial layers is presented. Author

N71-17318# Nebraska Univ., Lincoln. Electrical Materials Lab.
CHARACTERIZATION OF SEMICONDUCTOR SURFACES AND INTERFACES BY ELLIPSOMETRY
N. M. Bashara *In* NBS Silicon Device Process. Nov. 1970 p 457 Sponsored in part by ONR and NSF (See N71-17276 07-26)
Avail: SOD $5.50

A literature survey is presented on the application of ellipsometry to characterize contamination and defects of semiconductor surfaces. The technique has been used to investigate the band structure of solids, thin film annealing, detection of strain-induced optical perturbations, and modulated reflection of surfaces. R.B.

N71-17453# Iowa State Univ. of Science and Technology, Ames.
ERBIA-HAFNIA SYSTEM
James Keith Johnstone (Ph.D. Thesis) Oct. 1970 137 p refs
(Contract W-7405-eng-82)
(IS-T-401) Avail: NTIS

The phase relations in the erbia-hafnia system were studied after fixed-temperature anneals and at high temperatures by X-ray diffraction with emphasis placed on the cubic fluorite solid solution region. Solubility of erbia in hafnia is less than 1 mole %. Trace-quantity erbia dissolved in hafnia lowered the upper limit of the monoclinic to tetragonal transformation temperature from 1825 to 1725 C. The fluorite domain extends from 9 to 50 mole % Er_2O_3 at 1450 C and from 6 to 60 mole % erbia at 1900 C. A two-phase domain composed of fluorite and erbia solid solutions extends from 50 to 73 mole % erbia at 1450 C. The evidence suggests that the two-phase region is dome shaped and does not extend all the way to the liquidus curve. Author (NSA)

N71-17454# Cornell Univ., Ithaca, N.Y. Dept. of Applied Physics.
HARD SUPERCONDUCTING MATERIALS Progress Report, 1 Dec. 1969–30 Nov. 1970
J. Silcox and W. W. Webb 30 Nov. 1970 16 p refs
(Contract AT(30-1)-3029)
(NYO-3029-48) Avail: NTIS

Research is reported on: critical currents in hard superconductors, intrinsic fluctuations in superconductors, radiation effects and instabilities in weak superconductors, superconducting surface sheath, and superconducting thin films. NSA

N71-17455# Addis Translations International, Woodside, Calif.
OPTICAL PROPERTIES OF AMORPHOUS InSb, GaSb, and GaAs
J. Niklas et al Jul. 1970 6 p refs Transl. into ENGLISH from the German Report Prepared for Calif. Univ., Livermore
(UCRL-Trans-10480; CONF-700423-1) Avail: NTIS

Optical properties of amorphous evaporated layers of InSb, GaSb, and GaAs were studied by measuring their transmissions and reflections in the spectral regions of the absorption edges and the self-absorption regions so that the optical constants could be calculated by Kramers-Kronig method. Spreading out and displacement of the curves of transitions in the amorphous phases towards lower energies at varying degrees were observed in all three compounds. Least spectrum spreading in InSb was attributed to the fact that its absorption edge behavior is the reverse of that of the other two compounds. G.G.

N71-17456# State Univ. of New York, Stony Brook. Coll. of Engineering.
CORRELATION OF DISLOCATION STRUCTURE WITH MICROSTRAIN DAMPING IN COPPER CRYSTALS
John Raymond Dralla (M.S. Thesis) Jan. 1970 48 p refs
(Contract AT(30-1)-4073)
(NYO-4073-2) Avail: NTIS

The low frequency microstrain damping behavior of copper single crystals was explored over a range of crystallographic orientations and prior plastic deformation. Quantitative determination of the primary and forest dislocation densities and distributions was obtained at various stages of prestrain using sample sectioning and etch-pit techniques. In addition, the stability and reversibility of the damping phenomenon were explored by constant amplitude stress cycling experiments. The results indicated that there was a decrease in the energy loss per load-unload cycle with repeated stress cycling and that the process is reversible within the sensitivity of the technique. The correlation of damping and etch-pit studies indicate that the energy loss mechanism is a result of primary dislocation-forest dislocation interactions and not an impurity-dislocation interaction, as previously believed. Author

N71-17457# Sandia Corp., Albuquerque, N.Mex.
APPLICATION OF NEUTRON DAMAGE MODELS TO SEMICONDUCTOR DEVICE STUDIES
B. L. Gregory and W. Gwyn Dec. 1970 26 p refs Reprinted Sponsored by AEC
(SC-R-70-4351) Avail: NTIS

A hybrid recombination model has been formulated for neutron irradiated silicon which correctly predicts the minority carrier recombination in both the neutral and space charge regions of a device. Exact, one-dimensional, numerical calculations have been performed using this model and compared to reported V−I characteristics of irradiated p(+)n diodes. The calculated curves agree with the reported data within 20% over the seven decade span of currents in the investigations, for diode base resistivities from 0.25 Omega-cm to 17 Omega-cm. At low injection levels the calculated recombination occurs predominantly in the junction space charge region, whereas at high injection both the space charge region and neutral region can be important. Author (NSA)

N71-17458# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
ELECTRIC DIPOLE INTERACTIONS AMONG POLAR DEFECTS IN ALKALI HALIDES
A. T. Fiory Aug. 1970 47 p refs
(Contract AT(30-1)-2391)
(NYO-2391-117; Rept-1410) Avail: NTIS

Influence of electric dipole interactions among substitutional polar molecules and atoms in the alkali halides is studied in the systems KCl:Li, KCl:OH, RbCl:OH, NaBr:F, and KCl:CN. A maximum is observed in the d.c. dielectric constant at a temperature T sub max which is shown to be proportional to the average interaction energy. It is also shown that this is not a relaxation effect. A remanent polarization is observed at low temperatures, which is due to parallel-aligned pairs of dipoles experiencing a reorientation barrier. Specific heat and thermal conductivity measurements are also analyzed for the influence of interactions. Author

N71-17459# IBM Watson Research Center, Yorktown Heights, N.Y.
PROCEEDINGS OF THE TENTH INTERNATIONAL CONFERENCE ON THE PHYSICS OF SEMICONDUCTORS
Seymour P. Keller, Frank Stern, and John C. Hensel (Bell Telephone Labs., Inc., Murray Hill, N.J.), eds. Washington, D.C. AEC Aug. 1970 880 p refs Conf. held at Cambridge, Mass., 17–21 Aug. 1970 Sponsored by AEC
(CONF-700801) Avail: NTIS HC$9.00/MF$0.95

A total of 155 papers are presented in 23 technical sessions dealing with: hot electrons, multiphonon processes, phonons, polarons and magneto-optics, excitons and for uv, surfaces and magnetic semiconductors, optical properties and impurities, metal-semiconductor transition, tellurium band structure, fundamental optical properties, surface quantization and tunneling, excitons at high concentrations, energy band effects, amorphous semiconductors, acoustoelectric effects, light scattering, low mobility and disordered semiconductors, spin-dependent and other transport, and recent advances. NSA

N71-17460# California Univ., Berkeley. Lawrence Radiation Lab.
GLIDE AND CLIMB OF PRISMATIC DISLOCATION HALF-LOOPS IN HIGHLY PERFECT COPPER CRYSTALS
Yasuhiro Miura (Ph.D. Thesis) Aug. 1970 82 p refs
(Contract W-7405-eng-48)
(UCRL-19625) Avail: NTIS

Glide and climb of punched out prismatic edge dislocation half-loops in copper crystals were studied by a dislocation etch pit technique. Improved crystal growing procedures yielded copper crystals of dislocation density less than 1000 cm/ccm so that rows of large prismatic dislocation half-loops (radius ≈10mu) with Burgess vectors (110) could be introduced by a ball indentation on a (111) plane in an originally dislocation-free area of the crystal. Both a dislocation etch pit picture and an X-ray transmission topograph proved the low dislocation density of the crystals. The results were best interpreted by a model based on vacancy formation at the point of intersection of the dislocation and the crystal surface and pipe diffusion along the dislocation loop. Author

N71-17644# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
FORCED ELECTROMECHANICAL VIBRATIONS OF A SODIUM-CHLORIDE PLATE
Raymond D. Mindlin Oct. 1970 22 p refs
(Contracts Nonr-4259(13); DA-28-043-AMC-01731(E))
(AD-715137; TR-17) Avail: NTIS CSCL 20/12

A recent extension of the classical theory of elastic dielectrics, to include an interaction between strain and polarization gradient, admits the possibility of excitation of electromechanical vibrations in crystals with a center of material symmetry; i.e., those in which there can be no classical piezoelectric effect. The new equations are applied to a case of forced thickness vibrations of a plate of sodium chloride crystal and the fundamental frequency, mode shape and electromechanical coupling coefficient are calculated--all subject to an assumption, regarding boundary conditions, which can be tested experimentally. Author (GRA)

N71-17800# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DETERMINATION OF THE REFRACTIVE INDEX IN HIGHLY

REFLECTIVE DIELECTRIC MULTILAYERS [BRECHZAHLBESTIMMUNG AN HOCHREFLEKTIERENDEN DIELEKTRISCHEN VIELFACHSCHIEHTEN]

W. Heitmann et al May 1970 19 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 23, no. 4, 1 Sep. 1967 p 221–226

((D-12)-70-14) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A new method for the determination of the refractive index of thin dielectric films by measuring the transmissivity of multilayers during deposition is described and discussed. With this method the refractive indices of CaF2, Na3AlF6, MgF2, ThF4, PbF2, Sb2O3, ZnS and ZnSe (indifferent combinations of these materials) were determined. The results mostly agree with the values given in the literature. Only for films deposited on very porous films (e.g., on CaF2 films), considerably lower values for the refractive indices were obtained; this leads to the conclusion that a certain porosity is transferred from the lower layer to the adjacent film. Author

N71-17806*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

JUNCTION CAPACITANCE AS A FUNCTION OF VOLTAGE FOR DIFFUSED P-N DIODES WITH EXPONENTIAL DOPING GRADIENTS

Ira T. Myers and Julian F. Been Washington Feb. 1971 13 p refs

(NASA-TM-X-2179; E-5931) Avail: NTIS CSCL 20L

A method was developed for calculating the capacitance of a diffused p-n junction as a function of voltage. A single universal curve, based on an exponential doping gradient, permits the calculation of the capacitances of junctions with a wide variety of base doping levels and diffusion doping gradients. In particular, the method permits the calculation of capacitances at intermediate voltages where the junction behaves neither as a linear graded junction nor as an abrupt junction, but is intermediate between the two cases. Calculated and measured capacitances as functions of voltage were compared for a silicon power diode with good agreement. Author

N71-17818* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

METHOD OF MAKING IMPURITY-TYPE SEMICONDUCTOR ELECTRICAL CONTACTS Patent

Jackson C. Horton and Harry M. King, inventors (to NASA) Issued 20 Sep. 1966 (Filed 26 Nov. 1963) 6 p Cl. 264-27

(NASA-Case-XMF-01016; US-Patent-3,274,304; US-Patent-Appl-SN-326299) Avail: US Patent Office CSCL 09A

A brush assembly is described which gives excellent electrical conductivity and good lubrication for the contacting surfaces during operation in space environments. This assembly consists, in part, of a semiconductor current carrying medium of the type having charge carriers supplied by impurities deliberately introduced into the host material in large quantities. The degenerate semiconductor is then formed into brushes so that the grain orientation of the material is parallel to the plane of brush movement during operation. Impurity type semiconductors have been fabricated by sintering molybdenum disulfide with copper or silver at extremely high temperatures and pressures. NASA

N71-17825# Michigan State Univ., East Lansing. Dept. of Chemistry.

AN INVESTIGATION OF SOME LANTHANIDE BORON, CARBON, NITROGEN, SILICON, CHALCOGEN AND HALOGEN SYSTEMS AT ELEVATED TEMPERATURES Technical Progress Report, 1 Feb. 1970–31 Jan. 1971

Harry A. Eick 31 Jan. 1971 28 p refs

(Contract AT(11-1)-716)

(COO-716-66) Avail: NTIS

Single crystals of thulium carbide were prepared and submitted to crystallographic examination. The kinetics of the vaporization of SmOBr were studied. The vaporization of EuCl2 was studied at 1240 to 1705 K in order to establish accurate vapor pressure values and the derived thermodynamic quantities. Studies are underway on the vaporization of EuF and EuOF. YbBr2 was prepared and its crystal structure studied by X-ray diffraction. NSA

N71-17837# Iowa State Univ. of Science and Technology, Ames.

A TECHNIQUE FOR COOLING SINGLE CRYSTALS BELOW 90 K FOR X-RAY DIFFRACTION, AND THE CRYSTAL STRUCTURES OF H2Ta6Cl18.6(H2O), AND THE PHOTODIMER OF 1,1-DIMETHYL-2, 5-DIPHENYL-1-SILACYCLOPENTADIENE

Charles Burton Thaxton (Ph.D. Thesis) Sep. 1970 26 p refs (Contract W-7405-eng-82)

(IS-T-423) Avail: NTIS

An efficient and inexpensive method of cooling a crystal to low temperatures has been developed for single crystal X-ray diffraction investigations. The principal features of this system are the use of a float and microswitch mechanism to maintain a virtually constant liquid level in the boil-off chamber, and the use of a slow gravity fill procedure to reduce any pressure variations in the gas stream. The crystal structure of 1,1-dimethyl-2,5-diphenyl-1-silacyclopentadiene photodimer (silole dimer) has been determined, and the counter intensity data have been refined by anisotropic least-squares analysis. The silole dimer molecule contains a completely planar cyclobutane ring via the center of symmetry. The crystal structure of H2Ta6Cl18.6H2O has been determined as cubic and consisting of Ta6Cl18 anion clusters of O sub n symmetry, which pack in a diamond type lattice. Author

N71-17838# California Univ., Berkeley. Lawrence Radiation Lab.

QUANTITIVE PHASE ANALYSIS OF ROCKS BY X-RAY DIFFRACTOMETRY

Robert L. Braun and Lawrence D. Ramspott 10 Sep. 1970 21 p refs

(UCRL-50921) Avail: NTIS

An internal standard method of quantitative phase analysis by X-ray diffractometry is presented for the analysis of quartz, calcite, and dolomite. The indicated precision for a single measurement at the 95% confidence level is approximately 8% of the amount present for quartz and 20% for calcite and dolomite. Higher precision can be attained by replicate analysis. The indicated accuracy for analysis of a synthetic rock sample is within 2% of the amount present for 50 wt% quartz, 5 wt% calcite, and 5 wt% dolomite with five replicate analyses. During the analyses of 156 samples of alluvium and tuff, detectability limits of 0.5 wt% calcite and 1 wt% dolomite were obtained. Author

N71-17839# California Univ., Livermore. Lawrence Radiation Lab.

OPTICAL REFLECTANCE AND ELECTRONIC STRUCTURE OF DILUTE ALLOYS: ALUMINUM IN SILVER AND GOLD

G. B. Irani (Ph.D. Thesis) 13 Jul. 1970 89 p refs

(UCRL-50904) Avail: NTIS

Reflectance measurements at nearly-normal incidence were used to investigate the optical properties and electronic band structures of dilute alloys of Al in Ag and in Au. Samples were vapor-deposited, annealed, and measured in ultrahigh vacuum. Maximum concentrations of Al were 8.1% in Ag and 6.0% in Au. Reflectances were recorded at sample temperatures of 100 K and 300 K. A dispersion analysis of the reflectance was made. Optical functions were calculated and plotted with high resolution using a computer. The optical reflectometer, which permits automatic, continuous measurements over a photon energy range of 2 to 11.5 eV, is described in detail. Shifts in epsilon sub 2 structures indicate

that approximately one of aluminum's three valence electrons remains localized at the solute site, screening the ion-core potential. The other two electrons participate in the alloy conduction band, raising the Fermi level. Author

N71-17842# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MAGNATIC MOMENT VERSUS TEMPERATURE CURVES OF FERRIMAGNETIC GARNET MATERIALS
Gerald F. Dionne 9 Sep. 1970 58 p refs
(Contract AF 19(628)-5167)
(AD-715284; ESD-TR-70-50; TR-480) Avail: NTIS CSCL 20/12

The molecular field coefficients employed in the Neel theory of ferrimagnetism have been determined as functions of the levels of diamagnetic ion substitution in the garnet family (Y(z)Gd(3-z))(R(x)Fe(2-x))(Q(y)Fe(3-y))O(12), where R and Q represent diamagnetic octahedral and tetrahedral substitutions, respectively. With these coefficients the magnetic moment versus temperature curves of compositions ranging from $0 \leq x \leq 0.70$, $0 \leq y \leq 1.95$, and $0.40 \leq z \leq 1.00$ were computed and are presented in this report. Author (GRA)

N71-17879*# Marquardt Corp., Van Nuys, Calif.
RESEARCH ON LOW VOLTAGE ELECTROLUMINESCENT DEVICES WITH STORAGE, PHASE 3 Final Technical Report
Jacques M. Hanlet and H. Shimizu Jun. 1970 43 p refs
(Contract NAS12-545)
(NASA-CR-116443) Avail: NTIS CSCL 20L

The development of efficient electroluminescent systems operable at room temperature and applicable to storable and erasable visual read out devices is described; this includes the preparation and characterizations of the heterojunction ZnSe-AlAs and the Schottky junction Pt-ZnSe. Polycrystalline AlAs was prepared by reaction of arsenic vapor with molten aluminum and deposited on the natural (110) face of a ZnSe single crystal using a Knudsen type effusion system for AlAs evaporation. Initial results were not conclusive in that the film was not sufficiently adherent to the substrate to perform electronic characterizations. Comparative preliminary investigations were made on a Schottky emission junction of platinum evaporated on a single crystal ZnSe surface. A method was developed for the determination of optical constants in complex thin films by measuring transmittance from interference patterns. The performance of a demonstration multielement model consisting of sections of a large area thin film Pt-ZnSe p-i-n junction is described. Analytical investigations indicate that these systems hold promise of improved electroluminescent properties. Author

N71-17892# Rio Grande Do Sul Univ., Porto Alegre (Brazil).
INTERACTION OF ATOMIC NUCLEI WITH THEIR ENVIRONMENT BY NUCLEAR TECHNIQUES Final Report, 1 Apr. 1967 -31 Sep. 1970
Fernando C. Zawislak Sep. 1970 20 p refs
(Grant AF-AFOSR-1280-67)
(AD-715298; AFOSR-70-2832-TR) Avail: NTIS CSCL 20/12

The report discusses research under the contract in the following areas: Nuclear spectroscopy projects using gamma-gamma and electron-gamma angular correlations; Study of solid state properties of materials using perturbed angular correlations; Study of solid state properties of materials using Mossbauer effect; Laser physics; and Technical advances. GRA

N71-17982# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-VOLTAGE ELECTRON MICROSCOPY STUDY OF SLIP BAND GROWTH IN COPPER
T. Kosel and J. Washburn Aug. 1970 5 p refs Presented at the 2d Intern. Conf. on the Strength of Metals and Alloys, Pacific Grove, Calif., Sep. 1970
(Contract W-7405-eng-48)
(UCRL-19601; CONF-700819-6) Avail: NTIS

For radiation hardened and quench-hardened crystals, the dislocation loop substructure created by condensation of vacancies and/or interstitials is unstable in the presence of long dislocations. Clear channels are created by expansion of the first few glide loops resulting in strain softening in the layers of crystal immediately adjacent. Within the volume where a slip band has formed, the initially high dislocation density in the form of isolated closed loops was replaced by more stable dislocation tangles. The electron microscope observations were undertaken to see if a similar explanation can explain heavy slip band formation in copper which was prestrained in multiple slip. Author

N71-18045# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
A RADIATION EFFECTS RESEARCH PROGRAM Annual Report, 1 Mar. -31 Aug. 1970
W. W. Grannemann, R. C. Allen, Jr., L. T. Boatwright, W. J. Byatt, and H. D. Southward Sep. 1970 301 p refs
(Contract N00014-68-A-0158)
(AD-715140; EE-177(70)ONR-005) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/12

The report includes radiation effects on GaAsP and GaP schottky barrier diodes; Fabrication and electrical testing of Zn-Si and Zn-GaAsP schottky barrier diodes; The effects of neutron and gamma irradiation on diffused GaAs laser diodes; Radiation damage to epitaxial silicon measured by micro-Hall device; Hall effect in dielectric materials; Conductance measurements on metal-insulator-semiconductor capacitors; Metal-insulator-semiconductor (MIS) capacitor studies; Transistor modeling; Transient radiation effects in silicon controlled rectifiers; Theory of avalanche breakdown in silicon II; Particle transport and band structure within imperfect crystal; Transport equations with variable coefficients. Author (GRA)

N71-18048# Gulf General Atomic, San Diego, Calif.
OPTICAL STUDIES OF RADIATION DAMAGE PROCESSES Final Report, 25 Mar. 1968 -24 Jan. 1969
Rudolfo A. Casena, Terry M. Flanagan, Victor A. J. van Lint Oct. 1970 124 p refs
(Contract AF 19(628)-5838)
(AD-715305; GA-9865; AFCRL-70-0545) Avail: NTIS CSCL 20/12

A research program using the high dose rates available from an electron linear accelerator and fast optical techniques to study excitation-deexcitation, trapping, and radiation damage processes is presented. Radiation damage rates in gallium arsenide noncoherent and laser p-n junction diodes are compared by measuring the electrical characteristics and the electroluminescence output before and after irriation with fast electrons. A nonthermal, electrical annealing process is described which is effective in restoring the optical properties of irradiated diodes; the electrical characteristics, which are damaged by the radiation, are not restored by the anneal. To account for the various observations, a model is proposed in which the radiation does not introduce additional nonradiative recombination centers as previously thought but changes the radiative recombination centers to nonradiative. Potassium chloride is also investigated, and the shift in the peak absorption of the F-center with temperature is used to compute effective lattice frequencies. The self-bleaching of the F-centers and the energy required to form an F-center by ionization is experimentally determined as a function of initial F-center concentration and as a function of temperature. A value of 40 eV/F-center is measured at 300K at times of the order of microseconds after a radiation pulse; measurements a few seconds after the pulse yield a higher value due to the self-bleaching of the centers. Author (GRA)

N71-18047# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MECHANISM OF GROWTH OF WHISKERS FROM THE GAS PHASE

Ye. V. Borisov et al 17 Aug. 1970 19 p refs Transl. into ENGLISH from Fiz. Khim. Obrab. Mater. (USSR), no. 3, 1969 p 38-45

(AD-714799; FTD-MT-24-87-70) Avail: NTIS CSCL 20/2

The mechanism responsible for the growth of Si, Ge, and other types of whiskers from the gas phase is discussed in the light of the latest theoretical and experimental evidence. The crystallization process is treated as being due to a mechanism in which vortices carry particles of crystallizing material along as a result of the pressure difference between the outside and inside of the vortex system. Formulae for determining the rate of growth of such whiskers are derived, allowance being made for the surface diffusion of adsorbed atoms along the sides of the growing whiskers. GRA

N71-18048# Massachusetts Inst. of Tech., Cambridge. Semiconductor Materials and Devices Group.

NUCLEAR MAGNETIC RESONANCE IN LEAD TELLURIDE

Charles Robert Hewes 21 Oct. 1970 201 p refs

(Contract N00014-67-A-0204-0029)

(AD-715092; TR-1) Avail: NTIS CSCL 20/12

Nuclear magnetic resonance NMR measurements have been used to develop a detailed model of the energy band structure of Pb Te in the vicinity of the valence and conduction band edges. In addition, the hyperfine couplings between the carrier states and the Pb207 and Te125 nuclei have been determined. A parameterized k.pi nonparabolic model for the valence band conduction bands has been developed which takes account of the k.pi couplings among the six bands near the Fermi level at the L point of the Brillouin zone. From this band model, expressions are developed for the Fermi energy dependence of the g factors, the nonparabolic density of states, and the carrier concentration and temperature dependence of the Knight shift. The hyperfine coupling between the Pb207 nuclei band the valence band states is found to be nearly equal to the coupling between the Pb207 nuclei and the conduction band states. Both hyperfine constants are more than an order of magnitude larger than the hyperfine constant of the PB6S state for neutral atomic lead. Relativistic corrections are examined to account for the unusual magnitudes of both hyperfine constants. The PB207 resonance lineshape and resonance position were used to observe a damaged-induced compensation effect in p-type PbTe, which was not observed in n-type material. Author (GRA)

N71-18059# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.

CELL MODEL OF QUANTUM LIQUIDS AND SOLIDS. 1: CRYSTALLINE STATE

William J. Mullin 16 Nov. 1970 42 p refs

(Contract N00014-67-A-0230-0003)

(AD-714900) Avail: NTIS CSCL 20/12

A second quantized cell model Hamiltonian is derived to provide a model for quantum crystals and liquids. The Boson crystal is treated in this article. The cells are divided into two sublattices, regular which are usually occupied and interstitial which are usually empty. The particle hard cores are simulated by assuming Fermi commutation relations for operators referring to a single cell, this allows a discussion in terms of a spin analog Hamiltonian which is diagonalized in the spin wave approximation. Because the Hamiltonian includes a term which allows tunneling between regular and interstitial sites, the ground state includes a description of zero point motion and exchange via virtual intermediate interstitial occupation. Excited states include nonlocalized vacancies, interstitials and vacancy-interstitial pairs. Phonon states are not included in this analysis. The model exhibits a phase transition to the Bose condensed state which is examined briefly. Author (GRA)

N71-18063# Iowa State Univ. of Science and Technology, Ames.

CRYSTAL AND MOLECULAR STRUCTURES OF SELECTED ORGANOMETALLIC COMPOUNDS AND SOME DIRECT METHODS

Leslie Leon Martin (Ph.D. Thesis) Nov. 1970 140 p refs

(Contract W-7405-eng-82)

(IS-T-390) Avail: NTIS

California crystal structure of 2-(tetra trimethylsilyl cyclohexene-1-yl)heptamethyl trisilane was determined from three-dimensional single-crystal X-ray diffraction data collected by counter methods. The crystal and molecular structure of cis-dichlorobis (dimethyl phenyl phosphine)palladium(II) was derived from 2027 independent, nonzero reflections using conventional three-dimensional single crystal techniques. The crystal and molecular structure of nitrilo triacetodiaquo praseodymium(III)-monohydrate was established from 1111 independent, nonzero intensities using conventional heavy atom techniques. A method for relating the phases of reflections in a centric structure is described. The derivation of the basic equations, a description of the procedure, and the application of the procedure to a structure solution are presented. Author

N71-18064* Radio Corp. of America, New York.

GaAs SOLAR DETECTOR USING MANGANESE AS A DOPING AGENT Patent

Edward F. Pasierb, inventor (to NASA) Issued 6 Sep. 1966 (Filed 22 Jul. 1963) 4 p Cl. 317-234 Sponsored by NASA

(NASA-Case-XNP-01328; US-Patent-3,271,637; US-Patent-Appl-SN-296879) Avail: NTIS CSCL 20L

The vapor deposition of gallium arsenide films to manganese substrates to provide semoconductor devices with a low substrate resistance is described. The devices are suitable for application in solar energy converters requiring a low-resistance substrate. R.B.

N71-18065# New South Wales Univ., Kensington (Australia).

ELECTRON PARAMAGNETIC RESONANCE STUDY OF CLEAN AND OXYGEN EXPOSED SURFACES OF GaAs, AlSb AND OTHER 3-5 COMPOUNDS Annual Report, Aug. 1967-Jul. 1970

D. Haneman San Francisco Army Res. and Develop. Office Oct. 1970 59 p refs

(Grant DA-CRD-AFE-S92-544-69-G154)

(AD-714986; ARDG(FE)-440-2) Avail: NTIS CSCL 7/4

Information has been obtained about the surface wave functions, electron states, oxygen adsorption sites and adsorption modes on clean (110) surfaces of GaAs and related semiconductors. The principal method utilised electron paramagnetic resonance measurements of samples crushed and measured in ultra high vacuum. It was shown that the signal is caused by O2(-) ions formed on the GaAs surface. The signal is not reversible to pumping but disappears on warming to -100C and forms again only after re-exposure to oxygen at 77K. About 5% of the wave function of the unpaired electron on the O2(-) molecule ion is localised on the Al atom. The unfilled (dangling) orbital of this surface atom is found to be over 90% p type. This provides apparently the first experimental determination of a clean semiconductor surface wave function. A model of the (110) surface of a III-V compound semiconductor is proposed and the adsorption site of the O2(-) ion is specified. A solution for the g tensor has been obtained for the case of the low symmetry pertaining to the surface, and surface electric field gradients have been deduced. Author (GRA)

N71-18129# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

ANELASTIC PROPERTIES OF GRAPHITES IRRADIATED AT ROOM TEMPERATURE

D. Rouby, P. Gobin, R. Schill, and J. Rappeneau 1970 19 p refs In FRENCH Presented at the Conf. on Anelastic Effects Due

to Defects and Phase Transformations in Solids, Lausanne, Switzerland, 24-26 Jun. 1970
(CEA-CONF-1636; CONF-700624-2) Avail: AEC Depository Libraries

A study of the internal friction of a quasi-monocrystalline graphite very slightly irradiated (dose equal to 5 × 10 to the 16th power n/sq cm) revealed two populations of irradiation induced defects. One is formed by interstitials blocked in the lattice by the presence of an atom in Wallace position. These interstitials are reoriented at about 300 K with the appearance of peak P3 (relaxation peak in the curve representing the internal absorption variation as a function of temperature). The other consists of highly mobile simple interstitials in the conventional configuration which migrate towards dislocations where they form accumulations of several atoms. This leads to strong bonds able to trap dislocations by conversion into Wallace type accumulations. The detrapping of dislocations under the effect of applied stresses causes the appearance of peak P4 in the variation curve mentioned above. The reduction of peak P4 as a function of dose or annealing can be ascribed to the enlargement of accumulations on the dislocation lines. Author (NSA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N71-17192# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Ottobrunn (West Germany).
PROCEEDINGS OF THE NINTH MEETING OF THE WGLR ON ROCKET TECHNOLOGY [BERICHT UEBER DIE 9. SITZUNG DES WGLR-FACHAUSSCHUSSES FUER RAKETENTECHNIK]
Dec. 1969 82 p refs In GERMAN Conf. held at Porz, West Ger., 18 Apr. 1969
(DLR-Mitt-69-29) Avail: NTIS; ZLDI Munich: 17 DM

CONTENTS:

1. ON THE USE OF CATALYSTS IN SPACE TECHNOLOGY WITH SPECIAL CONSIDERATION OF THE MONERGOL CATALYSIS OF HYDRAZINE IN ROCKET ENGINES AND GAS GENERATORS D. Genthe (DFVLR, Trauen) p 7–29 refs (See N71-17193 07-27)

2. INVESTIGATION OF CATALYSTS WITH THE SCANNING ELECTRON MICROSCOPE H. Selzer (DFVLR, Trauen) p 31–44 refs (See N71-17194 07-27)

3. WORKING ON RANEY NICKEL CATALYSTS A. Basch (Varta AG, Kelkheim) and A. Winsel (Varta AG, Kelkheim) p 45–48 (See N71-17195 07-03)

4. TEST RESULTS WITH CATALYSTS FOR HYDRAZINE DECOMPOSITION IN ROCKET ENGINES EMPHASIZING QUICK IGNITION CAPABILITY H. Hopmann (Messerschmitt-Boelkow-Blohm G.m.b.H.) p 49–71 refs (See N71-17196 07-27)

5. USE OF BOELKOW CATALYSTS FOR HYDRAZINE, HYDRAZINE MIXTURES, AND HYDROGEN PEROXIDE FOR ROCKET ENGINES AND GAS GENERATORS W. Zeh (Messerschmitt-Boelkow-Blohm G.m.b.H.) p 73–81 (See N71-17197 07-27)

N71-17193# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Trauen (West Germany). Inst. fuer Chemische Raketenantriebe.
ON THE USE OF CATALYSTS IN SPACE TECHNOLOGY WITH SPECIAL CONSIDERATION OF THE MONERGOL CATALYSIS OF HYDRAZINE IN ROCKET ENGINES AND GAS GENERATORS [UEBER DEN EINSATZ VON KATALYSATOREN IN DER RAUMFAHRTTECHNIK UNTER BESONDERER BERUECKSICHTIGUNG DER MONERGOL-KATALYSE DES HYDRAZINS IN RAKETENTRIEBWERKEN UND GASERZEUGERN]
D. Genthe *In* DGLR Proc. of the 9th Meeting of the WGLR on Rocket Technol. Dec 1969 p 7–29 refs In GERMAN (See N71-17192 07-27)
Avail: NTIS; ZLDI Munich: 17 DM

Space technology applications of catalytic reactions are surveyed. Noble metal catalysts are important because of their high reliability, stability, and activity, and some applications are described. ESRO

N71-17194# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Trauen (West Germany). Inst. fuer Chemische Raketenantriebe.
INVESTIGATION OF CATALYSTS WITH THE SCANNING ELECTRON MICROSCOPE [DIE UNTERSUCHUNG VON KATALYSATOREN MIT DEM RASTERELEKTRONENMIKROSKOP]
H. Selzer *In* DGLR Proc. of the 9th Meeting of the WGLR on Rocket Technol. Dec. 1969 p 31–44 refs In GERMAN (See N71-17192 07-27)
Avail: NTIS; ZLDI Munich: 17 DM

The application of the scanning electron microscope to the analyis of hydrazine propellant catalysts is described. ESRO

N71-17196# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
TEST RESULTS WITH CATALYSTS FOR HYDRAZINE DECOMPOSITION IN ROCKET ENGINES EMPHASIZING QUICK IGNITION CAPABILITY [VERSUCHSERGEBNISSE MIT KATALYSATOREN FUER DIE HYDRAZIN-ZERSETZUNG IN RAKETENTRIEBWERKEN UNTER BESONDERER BERUECKSICHTIGUNG DER SCHNELLSTARTFAEHIGKEIT]
H. Hopmann *In* DGLR Proc. of the 9th Meeting of the WGLR on Rocket Technol. Dec. 1969 p 49–71 refs In GERMAN (See N71-17192 07-27)
Avail: NTIS; ZLDI Munich: 17 DM

Important effects arising during the development of quick responding catalysts for hydrazine decomposition in rocket engines and similar equipment are surveyed. Special attention is given to noble metal catalysts because of their spontaneous responses. ESRO

N71-17197# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
USE OF BOELKOW CATALYSTS FOR HYDRAZINE, HYDRAZINE MIXTURES, AND HYDROGEN PEROXIDE FOR ROCKET ENGINES AND GAS GENERATORS [ARBEITEN MIT BOELKOW-KATALYSATOREN FUER HYDRAZIN, HYDRAZINMISCHUNGEN UND WASSERSTOFFPEROXYD FUER TRIEBWERKE UND GASGENERATOREN]
W. Zeh *In* DGLR Proc. of the 9th Meeting of the WGLR on Rocket Technol. Dec. 1969 p 73–81 In GERMAN (See N71-17192 07-27)
Avail: NTIS; ZLDI Munich: 17 DM

The development of catalysts for hydrazine mixture and hydrogen peroxide rocket engines and gas generators, is described. ESRO

N71-17220# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Abteilung Reaktionskinetik.
EXPERIMENTAL INVESTIGATIONS OF THE REACTION

KINETICS OF 1.1 DIMETHYL HYDRAZINE AND OXYGEN [EXPERIMENTELLE UNTERSUCHUNGEN ZUR KINETIK DER REAKTION VON 1.1 DIMETHYLHYDRAZIN MIT SAUERSTOFF]

Thomas Just Aug. 1970 28 p refs In GERMAN; ENGLISH summary Sponsored by Deut. Forsch. Gemeinschaft
(DLR-FB-70-34) Avail: NTIS; ZLDI Munich: 8.30 DM

Measurements behind shock waves in diluted mixtures of dimethyl hydrazine (DMH)-oxygen-argon showed that DMH unimolecular decomposition occurred during the first stage and that during the second stage, clearly separated from the first one, the decay products reacted with oxygen. Values for the rate constant of the unimolecular decomposition are discussed. Author (ESRO)

N71-17227# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Raketentreibstoffe.

THE EFFECTS OF ADDING SOLID OXIDIZER TO HYBRID FUELS. PART 1: THE FLOX/AMMONIUM NITRATE/HYDROCARBON SYSTEM [WIRKUNGEN DER FESTOXYDATORBEIMENGUNGEN ZU LITHERGOLBRENNSTOFFEN. TEIL 1: DAS SYSTEM FLOX/NH4NO3/KOHLENWASSERSTOFF]

Roger E. Lo and Charles J. La Blonde Bad Godesberg, West Ger. Bundesmin fuer Bildung und Wiss. Aug. 1970 27 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-47) Avail: NTIS; ZLDI Munich: 5.25 DM

The effect of adding up to 30% ammonium nitrate to a hydrocarbon fuel is described. Using oxygen, fluorine, and their mixtures as oxidizers, performance went through a flat optimum between 10 to 20% of solid oxidizer content. Theoretical performances were calculated at various expansion ratios. ESRO

N71-17228# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.

SOME PROPERTIES OF LITHIUM HYDRIDE AND ITS USE AS A ROCKET FUEL. PART 3: THE DECOMPOSITION OF COMMERCIAL-GRADE LITHIUM HYDRIDE [EINIGE EIGENSCHAFTEN VON LITHIUMHYDRID IM HINBLICK AUF SEINE VERWENDUNG ALS RAKETENBRENNSTOFF. 3. TEIL: SELBSTZERSETZLICHKEIT VON KOMMERZIELLEM LITHIUMHYDRID]

Roger Edwin Lo Jul. 1970 37 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-26) Avail: NTIS; ZLDI Munich: 11.50 DM

Commercially available lithium hydride gives off gaseous hydrogen with lithium hydroxide monohydrate and the effects of hydrate concentration and temperature on this reaction were studied. A formula for calculating the hydrogen quantity as a function of storage time is given as it is important for hybrid rocket engines. The velocity of the reaction between lithium hydride powder and grains and moisture was determined and its relation to grain density and air humidity was studied. Author (ESRO)

N71-17229# Sandia Corp., Albuquerque, N.Mex.

LIQUID-PROPELLANT ROCKET ABORT FIRE MODEL

B. E. Bader, A. B. Donaldson, and H. C. Hardee Oct. 1970 35 p refs
(SC-RR-70-454) Avail: NTIS

When a rocket explodes on a launch pad, the rocket payload is subjected to a severe thermal environment. In many cases, the payload contains hazardous materials such as radioactive fuels used as the power source for radioisotope thermoelectric generators. The behavior of these hazardous materials in a launch abort environment is of prime concern in the safety analyses of such systems. Before the behavior of materials can be determined, however, it is necessary to define the environment to which they are subjected. The analytical development of a thermal flux model of a launch pad abort for a liquid-fuel rocket is presented. Author

N71-17230# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).

PHASE STABILIZATION OF AMMONIUM NITRATE: INVESTIGATIONS OF CERIUM COMPOUND EFFECTS ON STABILIZATION [DIE PHASENSTABILISIERUNG VON AMMONIUMNITRAT: UNTERSUCHUNGEN UEBER DIE BEEINFLUSSUNG DER STABILISIERUNG DURCH CERVERBINDUNGEN]

W. Engel 6 Jul. 1970 29 p refs In GERMAN
(Rept-8/70) Avail: NTIS

Ammonium nitrate was fused with 1 to 10% Ce(NO3)6. 6H2O, and (NH4)2Ce(NO3)6, and investigated by differential thermal analysis, X-ray diffraction, dilatometry, and thermogravimetry, in order to improve its phase stability, for use in solid propellants. ESRO

N71-17841# Advisory Group for Aerospace Research and Development, Paris (France).

HIGH ENERGY HYPERGOLICS [PROPERGOLS HAUTEMENT ENERGETIQUES]

P. Tavernier, J. Boisson, and B. Crampel 1970 346 p refs In FRENCH
(AGARD-AG-141-70) Avail: NTIS; HC$6.00/MF$0.95

A brief history of hypergolic rocket propellant development is followed by a discussion of their specific thermodynamic properties and chemical compositions. Considered are toxicity, combustion efficiency, storage and handling, compatibility with contacting materials, and bacterial corrosion. Also investigated are heat diffusion into combustion chamber walls, wall cooling, and wall ablation. Transl. by G.G.

N71-18066 Alabama Univ., University.

SUBSURFACE HETEROGENEITY AND AMMONIUM PERCHLORATE GAS-PHASE DECOMPOSITION AS A COMPOSITE PROPELLANT BURNING RATE CONTROLLING MECHANISMS

Leonard Hugh Caveny (Ph.D. thesis) 1969 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 70-1373

Mathematical models for the combustion of ammonium perchlorate (AP) and composite propellants were developed using numerical techniques that eliminate assumptions that are inconsistent with physical observations and the accuracy of experimental data. A composite propellant consists of oxidizer crystals (in this case, AP) held together by an elastomeric binder. The flame produced by propellant combustion (between 2500 and 3000 C) provides the energy to gasify binder and AP. AP burns with a very thin (1 to 4 microns thick) self-sustaining flame. The combustion products from the AP flame provide oxidizing reactants that combine with binder volatiles to produce the high temperature propellant combustion gases. The hypothesis for the model summarizes the important processes. Dissert. Abstr.

N71-18067# Stanford Univ., Calif. Stanford Electronics Labs.

ADVANCED RESEARCH IN PROPAGATION TECHNIQUES Quarterly Report, 20 May - 19 Aug. 1970

A. T. Waterman, Jr. Oct. 1970 13 p
(Contract DAAB07-70-C-0138)
(AD-714999; SU-SEL-70-061; ECOM-0138-2) Avail: NTIS CSCL 20/14

Report deals with research on propagation of microwaves between two points on earths surface separated a distance considerably beyond line of sight. Frequency used is 3.2 GHz. Receiving system employs an antenna array which permits wave

front sampling. Propagation measurements are supplemented by meteorological measurements of temperature, humidity turbulence, etc. Profiles of refractive index are obtained by flying a plane equipped with a microwave refractometer through the atmospheric path in which the signal is scattered. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N71-17284*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACOUSTIC AND AERODYNAMIC PERFORMANCE OF A 6-FOOT DIAMETER FAN FOR TURBOFAN ENGINES. 3: PERFORMANCE WITH NOISE SUPPRESSORS
Edward J. Rice, Charles E. Feiler, and Loren W. Acker Washington Feb. 1971 61 p refs
(NASA-TN-D-6178; E-5878) Avail: NTIS CSCL 21E

Inlet and exhaust noise suppressors for a 6-ft- (1.83-m-) diameter fan for a high-bypass-ratio turbofan engine were tested. The perforated-plate-on-honeycomb suppressors provided a much broader band noise attenuation than was predicted. Perceived noise level attenuations obtained due to the suppressors were 13 and 12 PNdB for simulated approach and takeoff conditions, respectively. The theory used for the design of the suppressors is discussed. In general, the theory predicts the frequency for peak attenuation but underpredicts the peak attenuation amplitude. For frequencies above and below peak, the observed attenuations are more than predicted. Degradations of aerodynamic performance caused by the noise suppressors were smaller than the experimental errors, which were estimated to be 2 percent. Author

N71-17331# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.
EXPERIMENTAL PERFORMANCE OF SMALL FLOX/POLYETHYLENE HYBRID ROCKET ENGINES [UEBER DAS LEISTUNGSVERHALTEN VON KLEINEN FLOX/POLYAETHYLEN-LITHERGOLTRIEBWERKEN]
R. E. Lo and H. A. Weiler. Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Oct. 1970 67 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-54) Avail: NTIS; ZLDI Munich: 13.65 DM

An average combustion efficiency of 98% of the theoretical value was obtained with engines of about 150 N and 400 N nominal thrust by optimizing injection-heads, geometrical configuration of the solid fuel and characteristic afterburning chamber length, as well as by introducing spoiler plates. The time variations of various parameters were studied in firings of up to 80 sec. Author (ESRO)

N71-17372# Advisory Group for Aerospace Research and Development, Paris (France).
HIGH TEMPERATURE TURBINES
Jan. 1971 587 p refs Presented at the 36th Meeting of the AGARD Propulsion and Energetics Panel, Florence, 21–25 Sep. 1970
(AGARD-CP-73-71) Avail: NTIS HC$6.00/MF$0.95

Cooling techniques for turbine blades of high temperature aeronautical gas turbine engines. Advanced cooling methods and the application of improved heat resistant materials are discussed. For individual titles, see N71-17373 through N71-17404.

N71-17373# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
HIGH ENTRY TEMPERATURE TURBINE ON TURBOREACTORS AND GAS TURBINES [DES HAUTES TEMPERATURES DEVANT TURBINE SUR TURBOREACTEURS ET TURBINES A GAZ]
P. Alesi *In* AGARD High Temp. Turbines Jan. 1971 14 p In FRENCH (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

High entry temperatures for gas turbine engines decrease specific wear and always augment reduced pressures so that gas turbines can compete with Diesel engines in operational performance. Studies on turbocompressors with increased inlet temperatures showed that specific power in simple and double fluxes of moderate expansion increased and that all compressor double flux expansion rates were augmented threefold. Increased temperatures at turbine inlets augment compression and improve the efficiency of compression diluting elements. Transl. by G.G.

N71-17374# National Gas Turbine Establishment, Pyestock (England).
HEAT TRANSFER CALCULATIONS FOR TURBINE BLADE DESIGN
J. Dunham and J. P. Edwards *In* AGARD High Temp. Turbines Jan. 1971 18 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

The operating temperature of a cooled turbine blade depends on the heat transfer rate from the hot gas stream, the heat conduction within the metal, and the heat convection to the cooling air. Discussed are methods of calculating these factors, and their application to blade design. The effect of cooling on turbine performance is also considered. Author

N71-17375# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
TEMPERATURE DETERMINATIONS IN THE BLADES OF CONVECTION COOLED TURBINES [DETERMINATION DES TEMPERATURES DANS LES AUBES DES TURBINES REFROIDIES PAR CONVECTION]
G. Chiron *In* AGARD High Temp. Turbines Jan. 1971 13 p refs In FRENCH (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

A mathematical method is presented for calculating the temperature distribution in a convectively cooled turbine blade by considering the temperature constraints imposed on blade life in the estimation. Comparison between experimental and theoretical results verify the validity of this method for short and median length operations. Transl. by G.G.

N71-17376# Rolls-Royce, Ltd., Bristol (England). Bristol Engine Div.
OLYMPUS 593 TURBINE COOLING
M. J. Holland *In* AGARD High Temp. Turbines Jan. 1971 21 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

Turbine cooling effectiveness and efficiency are defined for subsequent use in descriptions of cooling performance. The factors affecting the choice of cooling design point and the sources of cooling air are discussed. In particular, the use of 5th stage H.P. compressor air in place of compressor delivery air is shown to result in lower rotor blade temperatures for the H.P. turbine. The

differing environments and requirements for turbine stator and rotor blades are discussed, together with the importance of combustion chamber outlet gas temperature profiles. The turbine rotor and stator blades are convection-cooled and are fairly conventional. The evolution of the various blade cooling designs is described together with summaries of their cooling performance. Author

N71-17378# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
HEAT FLUX MEASUREMENTS ON FIXED TURBINE BLADES [MESURES DE FLUX DE CHALEUR SUR AUBES FIXES DE TURBINES]
Jacques Michard *In* AGARD High Temp. Turbines Jan. 1971 9 p refs In FRENCH; ENGLISH Summary (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

Experimental results obtained on a set-up including a moderately high temperature combustion chamber (1300 K) and two stages of fixed blades are presented. The first stage is used as a distributor, the other one turning the flow parallel to its upstream direction at the outlet. Heat transfer and local exchange coefficients obtained with an upstream Mach number of 0.2 and a Reynolds number of 25,000 per cm are analyzed. Author

N71-17380# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
DESIGN OF SMALL DIMENSION TURBINE BLADE BY THEORETICAL ANALYSIS [DESSIN D'UNE AUBE DE TURBINE DE PETITE DIMENSION AU MOYEN DE PROCEDURES THEORIQUES]
C. Loudet *In* AGARD High Temp. Turbines Jan. 1971 28 p refs In FRENCH; ENGLISH Summary (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

The method of blade boundary layer optimization due to Le Foll is used for the calculation of a small turbine blade, in incompressible flow, with Goldstein's method for the resolution of the inverse potential flow problem. A blade with a cusped trailing edge has been calculated for the following flow conditions: inlet angle 32 deg, outlet angle −54.8 deg and Reynolds number based on the chord and outlet velocity. This blade gives a theoretical loss coefficient, based on the dynamic outlet pressure, of 4.45%. The calculated losses are in good agreement with the experimental results taking into account the fact that a truly two dimensional flow could not be obtained during the tests. Author

N71-17381# United Aircraft of Canada, Ltd., Longueuil (Quebec).
AN EXPERIMENTAL COOLED RADIAL TURBINE
U. Okapuu and G. S. Calvert (Pratt and Whitney Aircraft, West Palm Beach, Fla.) *In* AGARD High Temp. Turbines Jan. 1971 12 p (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

A cooled radial turbine, suitable for compressor drive in a twin spool engine, was designed and is at present undergoing experimental evaluation. Assumed turbine design point conditions were 2300 degrees F inlet temperature, 17-1/2 atmospheres inlet pressure, 4.9 lbs/sec. mass flow rate, 5.1:1 turbine pressure ratio, 220 BTU/lb. enthalpy drop, and a rotational speed of 67,000 rpm. Turbine components are nickel alloy castings in which cooling air passages are incorporated. The design features of the turbine and the results of thermal and stress analyses of its components are described. Author

N71-17382# Motoren-und Turbinen-Union Muenchen G.m.b.H. (West Germany).
EFFUSION COOLING OF TURBINE BLADES
H. Prechter, A. Schoenbeck, and N. Scholz *In* AGARD High Temp. Turbines Jan. 1971 14 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

Theoretical and experimental investigations into the aerodynamic and thermodynamic performance of effusion cooled turbine blades are presented. To estimate the aerodynamic and cooling performance an extensive computer programme has been worked out, the physical background of which is described in this report. Few available experimental test results are drawn on to back up the theoretical procedure. Some parametric studies are presented showing the chord- and spanwise temperature distributions for an effusion cooled blade with different coolant flow distribution. The cooling effectiveness is investigated for various parametric changes and compared with that of an internally cooled blade. The aerodynamic behaviour reveals a considerable increase in profile loss coefficient of a porous turbine blade both with and without coolant effusion. The effect on overall engine performance by using an effusion cooled high pressure turbine in a modern turbo-jet engine is briefly discussed. Author

N71-17383# Sussex Univ., Brighton (England). School of Applied Sciences.
TRANSPIRATION-COOLED TURBINES
F. J. Bayley and A. B. Turner *In* AGARD High Temp. Turbines Jan. 1971 16 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

The steps in the development chain of air cooling for gas turbine components and transpiration cooling are described. The three modes of heat transfer involved in transpiration cooling (gas side heat transfer, coolant side heat transfer, and interstitial heat transfer) are discussed separately. Finally, consideration is given to the practical problems of transpiration cooling in advanced gas turbines. Author

N71-17384# Curtiss-Wright Corp., Wood-Ridge, N.J.
EXPERIENCE WITH TRANSPIRATION COOLED BLADES
S. Lombardo and S. L. Moskowitz (Sucola di Guerra Aerea) *In* AGARD High Temp. Turbines Jan. 1971 20 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

The propulsion system requirements of advanced aircraft necessitate incorporation of significant technological advances in the state-of-the-art of major components in the engine. These advances evolve from the use of advanced design concepts coupled with adequate testing to substantiate the performance and durability through component and full scale engine testing. Achievement of high turbine inlet temperatures in turbine engines through the use of transpiration air-cooled turbine blades is considered. Briefly reviewed are the various transpiration air-cooled turbine blades evaluated. This evaluation includes blade design aspects, modes of fabrication, and materials of construction. The results of component and full scale engine testing, up to 3000 F (1650 C), are also presented. Author

N71-17385*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
TURBINE COOLING: ITS LIMITATIONS AND ITS FUTURE
Jack B. Esgar *In* AGARD High Temp. Turbines Jan. 1971 25 p refs (See N71-17372 07-28)
(NASA-TM-X-66702) Avail: NTIS CSCL 21E

The relative merits of convection, transpiration, and full coverage film cooling methods were analytically investigated for local turbine inlet temperatures from 2000 to 3500 F, gas pressures from 5 to 40 atmospheres and cooling air temperatures from 600 to 1200 F. Effects of wall thickness and material temperature were also investigated. Transpiration or full coverage film cooling will probably be necessary to permit operation at local turbine inlet temperatures on the order of 3000 F and compressor pressure ratios of 20 or higher. Full coverage film cooling is often superior to transpiration cooling because oxidation problems with transpiration

cooled materials reduce allowable metal operating temperatures. Increasing allowable metal temperature 100 F or reducing cooling air temperature 200 F can do more to improve convection cooling than is possible by improvements in current advanced state-of-the-art convection cooled blade or vane design. Author

N71-17386# General Electric Co., Cincinnati, Ohio.
HIGH TEMPERATURE TURBINE DESIGN CONSIDERATIONS
S. N. Suciu *In* AGARD High Temp. Turbines Jan. 1971 29 p refs (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

The major technological developments which have made possible the trend towards higher temperatures in modern aircraft gas turbine engines are discussed. The relative importance of manufacturing processes, material developments, cooling techniques, analytical design procedures, rupture and cyclic life considerations, and aerodynamic and mechanical design improvements are discussed along with illustrative examples and technical data. The need for a balanced design approach is stressed, and examples are given where trade offs can be made. It is noted that the advances in aircraft engines during the last 10 years have been based on the evolution of sound engineering principles, extensive component and engine development, and careful consideration of the operational requirements rather than a tremendous breakthrough or revolutionary concept in any one area. Author

N71-17387# Technische Hochschule Aachen (West Germany). Inst. fuer Strahlantriebe.
EXPERIMENTAL INVESTIGATION ON A SINGLE-STAGE AIR-COOLED GAS TURBINE
W. Kuehl *In* AGARD High Temp. Turbines Jan. 1971 14 p refs (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

Temperature measurements made within the convection air-cooled rotor blade of a gas turbine during operation cannot deliver complete information of the temperature field; for the number of measuring points is limited by technical considerations. But by using the analogy between the heat flux and the electric current within a three-dimensional model it is possible to determine the heat flow in a complete blade, i.e. the full temperature field within the blade and also the local gas side and coolant side heat transfer coefficients. This paper describes the way from temperature measurements at the turbine rotor to the complete temperature field within the rotor blade. Author

N71-17388*# Minnesota Univ., Minneapolis. School of Mechanical Aerospace Engineering.
FILM COOLING WITH INJECTION THROUGH HOLES
E. R. G. Eckert *In* AGARD High Temp. Turbines. Jan. 1971 19 p refs Sponsored by NASA and the Navy (See N71-17372 07-28)
(NASA-CR-116376) Avail: NTIS CSCL 21E

Film cooling with ejection through a row or rows of holes is under consideration for gas turbine blades. Discussed is an analytical approach to the prediction of the effectiveness of this cooling method developed in analogy to a method which proves successful for ejection through a slot and some experimental results which are compared with prediction obtained by this analysis. Author

N71-17389# Centre National de Recherches Metallurgiques, Liege (Belgium).
MEETING REQUIREMENTS FOR HIGH TEMPERATURE GAS TURBINES A CHALLENGE TO METALLURGISTS
D. Coutsouradis *In* AGARD High Temp. Turbines Jan. 1971 17 p refs (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

Metallurgists involved in the development of materials for high temperature gas turbines are challenged by problems of increasing difficulty leading them to explore continually new areas. Some of the current approaches used for the improvement of cobalt and nickel base alloys are reviewed and illustrated. The scope is not limited to an increase in strength but also to insuring structural stability, hot corrosion resistance, coatability. Processing variables such as hot deformation of normally cast alloys, controlled and directional solidification of conventional or eutectic type alloys, powder metallurgy techniques, are evaluated. Author

N71-17392# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Corbeil (France).
MATERIALS DEVELOPMENT FOR HIGH TEMPERATURE TURBINES [EVOLUTION DES MATERIAUX POUR TURBINES A HAUTE TEMPERATURE]
Robert Brunetaud *In* AGARD High Temp. Turbines Jan. 1971 8 p In FRENCH; ENGLISH summary (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

Turbine blades and vanes work in complex conditions with creep, thermal fatigue, corrosion, erosion, etc. Base cobalt and base nickel alloys are developed for these turbine parts in new processes (vacuum melting, vacuum precision casting, unidirectional solidification). Spectacular advantages are possible with niobium alloys but the problems of niobium coatings are not resolved. Low cycle fatigue has to be considered more than creep aspects in disk fabrication. New techniques of isothermal forging or the use of wrought sintered products are indicated for the manufacturing of modified alloys from materials used for blades. Author

N71-17401# National Gas Turbine Establishment, Pyestock (England).
SOME MECHANICAL DESIGN PROBLEMS OF TURBINE BLADES AND DISCS
J. B. Bullard and B. B. Baxendale *In* AGARD High Temp. Turbines Jan. 1971 19 p refs (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

Internally air-cooled turbine rotor blades usually have a non-uniform temperature distribution. The non-uniform stress pattern thus created is redistributed by creep occurring at different rates within the blade depending on the local value of stress and temperature. The effect of this process on the blade life is discussed and experiments to check the validity of some of the assumptions are described. The stress patterns in rotating discs are modified when plastic strain occurs dependent on the strain-hardening characteristics of the disc material. This places limitations on the use of conventional material properties as design data. These limitations and the effect of the material stress-strain curve on stress redistribution are discussed. Author

N71-17402# Air Force Systems Command, Wright-Patterson AFB, Ohio.
AIR FORCE AERO PROPULSION LAB. AIR-COOLED TURBINE DESIGN CRITERIA
Jack Richens *In* AGARD High Temp. Turbines Jan. 1971 6 p (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

A new technology for gas turbine engines is developed and applied in new engines. In order to accomplish this, a phased development cycle has been established that permits high levels of risk in the early stages of development reducing to low levels of risk prior to commitment of the substantial resources necessary for development for production. The development cycle with particular attention to the design or selection criteria that have been or are being successfully applied to air-cooled turbines, is described. Author

N71-17414*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF A SHORT MODULAR TURBOJET COMBUSTOR SEGMENT USING ASTM-A1 FUEL

Richard W. Niedzwiecki and Harry M. Moyer Washington Feb. 1971 33 p refs

(NASA-TN-D-6187; E-5726) Avail: NTIS CSCL 21E

A 27-inch long rectangular combustor segment consisting of an array of 48 combustor modules was tested to determine its performance. Each module mixed and swirled fuel with air and stabilized combustion. Test conditions were inlet temperatures of 600 and 1150 F, a pressure of 3 atmospheres, and reference velocities to 160 ft/sec. Results were combustion efficiencies of 100 percent, a pressure loss of 5.4 percent for an inlet Mach number of 0.25, a heat release rate of 11,860,000 Btu per (hr)(ft3)(atm) for a temperature ratio of 2.5, and pattern factor spans of 0.30 to 0.37 and 0.22 to 0.28 with 600 and 1150 F inlet air temperatures, respectively. Altitude blowout and relight data, as well as a comparison of results with a longer combustor, are also included. Author

N71-17483# National Aviation Facilities Experimental Center, Atlantic City, N.J.

INVESTIGATION OF JET ENGINE COMBUSTION CHAMBER BURN-THROUGH FIRE Final Report, 1963 - 1969

Thomas Rust, Jr. Mar. 1971 49 p refs

(FAA-RD-70-68; FAA-NA-70-40) Avail: NTIS

Test conditions for testing materials which are intended for use as fire barriers for protection against a jet engine combustion chamber burn-through type of failure are presented. The development of such a failure was accomplished on a General Electric J-47 jet engine. The resulting flame was quite severe, penetrating the present standard firewall material in 2 seconds. Studies were made of the flame impingement characteristics, including impingement temperatures and pressures; and various potential firewall materials were tested for effectiveness as fire barriers for protection against such a failure. Most materials tested in this manner failed to provide adequate protection against such an engine failure. An investigation was conducted toward development of a means of simulating a combustion chamber burn-through failure with the ultimate goal of developing a suitable laboratory test flame for evaluating potential firewall materials. A combustion chamber simulator, which will produce a flame of similar severity to the flame produced in the J-47 engine, was developed. Author

N71-17503*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AXISYMMETRIC EXPANSION OF A PLASMA IN A MAGNETIC NOZZLE INCLUDING THERMAL CONDUCTION

Eddie L. Walker and George R. Seikel Washington Feb. 1971 62 p refs

(NASA-TN-D-6154; E-5888) Avail: NTIS CSCL 20I

The axisymmetric expansion of a fully ionized, hot-electron cold-ion plasma in a magnetic nozzle is analyzed with thermal conduction included. Computed is the on-axis ratio of the directed ion exhaust energy to the maximum (upstream) electron thermal energy as a function of two parameters: (1) the on-axis sonic point location, and (2) a dimensionless magnetic field which involves the ratio of the maximum value of the applied magnetic field to an effective electron Hall parameter. The results differ sharply from that of an adiabatic expansion, with the energy ratio attaining values more than an order of magnitude greater than the adiabatic value. Limitations of the analysis are discussed along with an application to low power MPD arc thrusters. Author

N71-17504*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL INVESTIGATION OF HEAT-TRANSFER CHARACTERISTICS OF A FILM-COOLED PLUG NOZZLE WITH TRANSLATING SHROUD

Francis C. Chenoweth and Arthur Lieberman Washington Feb. 1971 63 p refs

(NASA-TN-D-6160; E-5551) Avail: NTIS CSCL 20M

An experimental study of the application of gaseous film cooling to the surface of a plug nozzle was conducted. The nozzle model was 8.5 in. (21.6 cm) in diameter, and the maximum gas temperature was limited to 1000 R (555 K). The Hatch-Papell film cooling correlation was used to predict plug and shroud surface temperatures. Application of the correlation used local conditions for the primary stream and slot conditions for the coolant stream. The agreement between predicted and measured surface temperatures under varying conditions of nozzle pressure ratio, coolant-weight-flow ratio, coolant slot geometry, and nozzle geometry are discussed. Author

N71-17505*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A GENERAL PURPOSE DIGITAL SYSTEM FOR ON-LINE CONTROL OF AIRBREATHING PROPULSION SYSTEMS

Dale J. Arpasi, John R. Zeller, and Peter G. Batterton Washington Feb. 1971 25 p refs

(NASA-TM-X-2168; E-5795) Avail: NTIS CSCL 21A

A digital system to facilitate development of airbreathing propulsion system controls is described from an operational and design viewpoint. The system is portable and capable of real-time on-line operation in the range of dynamics normally encountered in airbreathing propulsion systems. Author

N71-17506*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYTICAL HEAT TRANSFER INVESTIGATION OF INSULATED LIQUID METHANE FUSELAGE TANKS FOR SUPERSONIC CRUISE AIRCRAFT

Eugene J. Pleban Washington Feb. 1971 15 p refs

(NASA-TN-D-6157; E-5910) Avail: NTIS NTIS CSCL 20M

Liquid methane boiloff from fuselage tanks was computed for typical SST missions for cruise Mach numbers of 2.7 and 3.5, insulation thicknesses of 0.5, 1.0, and 2.0 in., various vent pressure settings, and saturated and subcooled fuel. Boiloff rates during fuel fill and ground hold are discussed. Boiloff losses less than 2.5 percent are possible for a cruise Mach number of 2.7 and an insulation thickness of 1.0 in. Author

N71-17507*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPACE FLIGHT WITH ELECTRIC PROPULSION

1969 51 p

(NASA-TM-X-66704) Avail: NTIS CSCL 21C

Various systems of electric propulsion for manned and unmanned spacecraft are described. Systems discussed are: (1) electric thrusters, (2) nuclear-turboelectric system, (3) nuclear thermionic system, (4) nuclear magnetohydrodynamic system, (5) solar cell system, and (6) nuclear rocket propulsion. The application of electric propulsion to the SERT 1 and 2 spacecraft is presented. Author

N71-17554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF AN AUXILIARY INLET EJECTOR NOZZLE WITH FLOATING INLET DOORS AND FLOATING SINGLE-HINGE TRAILING-EDGE FLAPS

Albert L. Johns Washington Feb. 1971 45 p refs

(NASA-TM-X-2173-E-5883) Avail: NTIS CSCL 21A

A nozzle designed for a supersonic-cruise aircraft was tested

at off-design Mach numbers from 0 to 1.0. Two primary throat areas were tested: one to simulate both dry acceleration and subsonic cruise, and the other to simulate reheat acceleration. The auxiliary inlet doors included single- and double-hinge types which were free-floating either with or without synchronization. Results from this cold-flow model are compared with a similar nozzle which was optimized using fixed inlet doors and flaps. The inlet doors and trailing edge flaps did not float to the maximum thrust condition at subsonic-cruise Mach numbers. In addition, the single-hinge flaps were unstable at many of the assumed flight conditions. Author

N71-17566*# TRW Systems Group, Redondo Beach, Calif. Propulsion Technology Section.

CHARACTERIZATION EVALUATION OF THE ATTITUDE CONTROL PROPULSION SYSTEM Interim Report

P. F. Thompson, T. J. Walsh, and R. S. Hoyle Dec. 1970 135 p refs

(Contract NAS9-8166)

(NASA-CR-114851; TRW-17618-H070-R0-00) Avail: NTIS CSCL 21H

Analyses of the design and development of attitude control propulsion systems (ACPS) for space mission applications to establish optimum system concepts are discussed. These analyses consist of parametrically generating sufficient component and subsystem data to permit evaluation of ACPS concepts which meet a variety of mission objectives for a wide range of operating conditions. Emphasis is placed upon reusability, light weight, high performance, safety, reliability and low cost for all components of future spacecraft. It is imperative that the analytical tools available for performing these analyses provide the capability to parametrically integrate system components into a variety of ACPS configurations to define optimum subsystem configurations. These analysis programs must also be capable of evaluating point designs of potential systems, determining the effects of component operation on overall system performance, determining system performance under both design and off-design conditions and characterizing final ACPS design configurations. Author

N71-17641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER PROGRAM FOR PRELIMINARY DESIGN AND ANALYSIS OF V/STOL TIP-TURBINE FANS

Henry C. Haller, Seymour Lieblein, and Bruce M. Auer Washington Feb. 1971 143 p refs

(NASA-TN-D-6161; E-5660) Avail: NTIS CSCL 21E

An analysis of a tip-turbine driven lift fan was developed for use in preliminary design or parametric investigation of tip-turbine lift fan systems applicable to V/STOL aircraft. The analysis was programmed for an electronic digital computer with provisions for treating a fan rotor with either one- or two-stage tip turbines mounted on the fan periphery. Both turbine types have impulse rotors with single-stage designs employing impulse, diffusing, or no exit stators. The program includes tip-turbine velocity diagram determination, blade row loss analysis, partial admission, and turbine-to-fan leakage. A sample calculation is given. Author

N71-17723*# Rocketdyne, Canoga Park, Calif.

NONCIRCULAR ORIFICE HOLES AND ADVANCED FABRICATION TECHNIQUES FOR LIQUID ROCKET INJECTORS. PHASE 2: ANALYTICAL AND EXPERIMENTAL STUDY OF NONCIRCULAR INJECTOR ORIFICES, AND ELEMENTS FOR GAS/LIQUID INJECTORS Final Report

R. M. McHale 22 Feb. 1971 181 p refs

(Contract NAS9-9528)

(NASA-CR-108571; R-8411) Avail: NTIS CSCL 21H

An analytical and experimental study of injector elements incorporating noncircular orifices for application with gas/liquid propellant combinations is presented. Based upon the results of a preliminary analysis and evaluation of several candidate injector elements, a rectangular concentric tube element was selected for further evaluation. Cold flow tests and subsequent analytical combustion modeling conducted with this element, and a standard, circular concentric tube demonstrated that the rectangular concentric tube element concept was superior, in many ways, to conventional injector concepts, especially in the area of propellant atomization. Author

N71-17724*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF FUEL DISTRIBUTION AND FLAME STABILIZATION TECHNIQUES ON COMBUSTION STABILITY LIMITS FOR SWIRL-CAN COMBUSTOR MODULES BURNING ASTM-A1 FUEL

Daniel C. Briehl and Robert D. Ingebo Washington Feb. 1971 19 p refs

(NASA-TM-X-2185; E-5968) Avail: NTIS CSCL 21E

A series of 10 single swirl-can combustor modules were tested with 40 percent area blockage in a 3.25-in. diameter duct in 600 F air streams at reference velocities of 75 to 600 ft/sec and a pressure of 1 atm. Combustion stability-limit (blowout) data were obtained for each module consisting of a fuel distributor, an air swirler, and a flame stabilizer. The ratio of rich-to-lean combustion stability limits was decreased when the uniformity of fuel distribution was improved for reference velocities up to 400 ft/sec. Optimum performance of conical flame stabilizers was obtained at a cone half-angle of approximately 15 to 20 deg. Author

N71-17725 Alabama Univ., University.

THE EFFECT OF TAILPIPE LENGTH ON COMBUSTOR STABILITY

John Amos Belding, Jr. (Ph.D. Thesis) 1969 184 p

Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 70-1365

A theoretical analysis of an adiabatic homogeneous reactor was carried out for a ramjet type combustor in order to describe the effect of an increase in tailpipe length on stability limits. Correlation of combustion loading, with known homogeneous reactor data was made in order to verify results of the theoretical analysis. General theoretical computer programs are included. A ramjet type combustor using premixed air-fuel was constructed. The combustor consisted of a two inch diameter tube which housed a disk bluff body flameholder. Various tailpipe lengths were also constructed. Experimental data pertinent to the combustor loading parameter were obtained. These data included total and static pressure measurements outside the flame front, flame front radii and recirculation zone radii, all measured at various locations down the duct. In addition, the lengths of the recirculation zone were measured. Dissert. Abstr.

N71-17728# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF THE EFFECT OF ATMOSPHERIC HUMIDITY ON THE CHARACTERISTICS OF A TURBOFAN ENGINE

B. D. Fishbeyn et al [1970] 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 2, 1967 p 112–118

(AD-715232; FTD-HT-23-290-68) Avail: NTIS CSCL 21/5

A mathematical method is presented for the study of the humidity effect on parameters of any gas-turbine engine. Author (GRA)

N71-17761*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY INVESTIGATION OF PERFORMANCE OF A

WEDGE NOZZLE APPLICABLE TO A SUPERSONIC-CRUISE AIRCRAFT

Albert L. Johns and Robert J. Jeracki Washington Feb. 1971 34 p refs

(NASA-TM-X-2169; E-5894) Avail: NTIS CSCL 20D

An experimental cold-flow investigation was conducted to determine the performance of a wedge nozzle with a design pressure of 31.5. A translating outer cylindrical shroud was used to control internal expansion ratio. External flow effects were measured from takeoff to Mach 1.0 for a retracted shroud configuration. Subsonic-cruise performance was about 1 percent higher than that obtained for a conical plug nozzle. At most Mach numbers tested the nozzle efficiency was rather insensitive to nozzle pressure ratio. This insensitivity to pressure ratio probably resulted from low external drag. In addition, the projected area of the primary flap was only 4.8 percent of the maximum model area. Nozzle efficiency at supersonic cruise was about 1 percent lower than that obtained with a typical axisymmetric ejector nozzle. Author

N71-18034# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF THE INJECTION ANGLE ON GAS DYNAMICS OF FAN JETS IN THE DEFLECTED FLOW

V. A. Kosterin et al 4 Sep. 1970 11 p refs Transl. into ENGLISH from Aviats. Inst., Kazan, Tr. (USSR), no. 101, 1968 p 32–38

(AD-714790; FTD-HT-23-443-70) Avail: NTIS CSCL 21/5

The article presents the results of investigation of the gas dynamics of fan jets at various injection angles from 60 degrees to 135 degrees. To increase the effectiveness of GTE afterburners, the flame is converted to jet or gas dynamic stabilization which produces a zone of backflows by injecting the gas jet (air, gaseous fuel, or a mixture) into the flow of combustible mixture. The limits of stable combustion in jets depend essentially on the parameters determined by the gas dynamics of the stream in the zone of interaction of jets with a flow. Author (GRA)

N71-18036# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.

ESTIMATION OF SUPERSONIC COMPRESSOR EFFICIENCY

W. Wells and R. E. Pavri Oct. 1970 16 p refs

(Contract DAHC04-69-C-0016; Proj. Themis)

(AD-715005; THEMIS-AE-70-15; AROD-T-4-21-E) Avail: NTIS CSCL 13/7

A semi-empirical determination of the adiabatic efficiency of a supersonic compressor stage is obtained. The method utilizes the normal shock relations, a recently developed efficiency expression for subsonic cascade flow and experimental pressure loss data from supersonic cascades of various geometrical shapes. A correction factor is determined which makes it possible to convert the subsonic stage efficiency to the case of supersonic flow involving shock losses. Author (GRA)

N71-18049*# Aerojet-General Corp., Downey, Calif. Nuclear Systems.

PROPULSION/ELECTRICAL POWER GENERATION Final Report

Dec. 1970 143 p

(Contracts NAS8-26346; SNP-1)

(NASA-CR-103038; ANWA-PEP13-W395) Avail: NTIS CSCL 21C

The feasibility of using the NERVA rocket engine as a heat source for generating 25 kw of electrical power is discussed. An organic Rankine power-conversion system, with a hydrogen-filled primary loop and heat-rejection system is described. The heat-rejection system utilizes the stage meteoroid shield as the radiating surface. The dual-mode feature provides a means to greatly increase the utilization of the NERVA engine as an energy source and permits increased operating flexibility. For planetary missions the capability of generating electrical power permits increased payloads. For short-duration missions the reduced duration of cooldown thrusting and the reduction of fluid requirements during cooldown are significant. Author

N71-18138*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

UNSTART AND STALL INTERACTIONS BETWEEN A TURBOJET ENGINE AND AN AXISYMMETRIC INLET WITH 60-PERCENT INTERNAL-AREA CONTRACTION

David A. Choby, Paul L. Burstadt, and James E. Chalogeras Washington Mar. 1971 38 p refs

(NASA-TM-X-2192; E-5923) Avail: NTIS CSCL 21E

The effects of inlet unstart on engine operation and the characteristics of stall propagation through the compressor and inlet system are discussed. With inlet unstarts at Mach 1.98, the instantaneous compressor pressure ratio which stalled the engine correlated with the steady-state value of the stall compressor pressure ratio. The unstart transient was so large at Mach 2.50 that it caused abrupt compressor stall at all engine operating conditions. Compressor stalls obtained by back-pressuring the engine at Mach 2.50 initiated hammer shocks through the inlet which caused surface static pressures to exceed freestream total pressure. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N71-16953# Lockheed Missiles and Space Co., Palo Alto, Calif.

X-RAY POLARIMETER FOR SOLAR FLARE RESEARCH

I. P. Tindo et al [1970] 6 p refs Transl. into ENGLISH from Kratkie Soobshch. Po Fiz. (USSR), no. 7, Jul. 1970

Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Existing data of optical, x-ray, and radio observations have not yet permitted any clarification of which of the mechanisms of hard radiation generation (brehmsstrahlung, synchrotron, Compton) is dominant in non-thermal flares. The detection and investigation of possible polarization of the x-radiation of solar flares would uniquely verify their non-thermal nature, and would permit clarification of the specific radiation mechanism. Measurement of x-ray polarization is possible by utilizing Thomson scattering, the photoelectric effect, and the effect of anomalous transparency of crystals. A device based on utilization of Thomson scattering effects was developed on the Interkosmos-1 satellite. Shown schematically is the unit for the polarimeter transducer block. The polarized radiation under investigation is scattered anisotropically by beryllium plates around which three pairs of x-ray photon counters are symmetrically disposed. The degree of polarization and the position of the polarization plane, are determined uniquely by the difference in the counting rates of the pulses in the three measurement channels by using the formulas presented. Author

N71-16954# Lockheed Missiles and Space Co., Palo Alto, Calif.

ROCKET STUDY OF THE SUN

C. A. Gurzadian [1970] 3 p Transl. into ENGLISH from Krasnaia Zvezda (Moscow), no. 234(14282), 8 Oct. 1970

Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The use of a rocket observatory to observe solar activity

is discussed. In order to trap X-ray and shortwave radiation of cosmic origin, it is necessary to lift the recording apparatus more than 100 kilometers above the earth's surface. This is the operating arena of high altitude rockets and artificial earth satellites. The use of the rocket astro-physical observatory to study the solar corona, chromosphere, and flares in the ultraviolet and x-radiation domains is described. Author

N71-16966# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
AERONOMY RESEARCH AT RICHLAND, WASHINGTON Annual Report
R. J. Hoch Aug. 1970 218 p refs
(Contract AT(45-1)-1830)
(BNWL-1484) Avail: NTIS

A brief history of research on stable auroral red (SAR) arcs is presented. Results of observations of SAR arc from Richland, Washington, during the period September 27, 1967, through March 31, 1970, are described. Twenty-three events are divided into 15 definite and eight probable SAR arcs. Typical features and behavior of the SAR arcs are described and the location of 14 arcs is shown. A record of all observations, visibility, and geomagnetic activity is appended. A first estimate of probability of SAR-arc occurrence on a given night is 0.09. NSA

N71-16968# Lockheed Missiles and Space Co., Palo Alto, Calif.
SCIENCE EXTENDS ITS HORIZONS: TOWARDS THE SUN
V. Krat [1970] 4 p Transl. into ENGLISH from Pravda (Moscow), no. 321 (19099), 17 Nov. 1970
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

An automatic solar observatory was launched into the stratosphere. The Soviet stratospheric observatory is the largest in the world in the size of the principal mirror of the telescope. The principal astronomical instrument of the station, a Cassegrainian telescope system, permits pictures and spectrograms of the sun to be obtained. This is done simultaneously by utilizing a special automatic magnification camera and high resolution diffraction spectrograph. Because of the large size of the picture of the sun reproduced by the camera on the films, granules and jets can be lost among the numerous shallow solar formations. Photographs are made simultaneously by using a smaller telescope, a photo-heliograph. A special marker on these films, which yields a smaller picture of the sun, indicates the place photographed by the large telescope. Author

N71-17005 Lockheed Missiles and Space Co., Palo Alto, Calif.
WANDERERS OF THE UNIVERSE
G. Liubimov et al. [1970] 3 p Transl. into ENGLISH from Pravda (Moscow), no.347(19125), 13 Dec. 1970 p 3
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The moon rover is provided with radiometer apparatus to measure the characteristics of galactic and solar cosmic rays. When a charged particle passes through the detector of the measuring apparatus, current pulses originate which are also recorded. Semiconductor detectors recognize solar cosmic ray protons with 1 - 5 million electron-volt energies which arrive from different directions. A gas-discharge counter, mounted externally on the moon rover as the semiconductor detectors, determines protons with energies more than 40,000 electron-volts. By comparing the measurements of the gas-discharge and semiconductor counters, the flux of solar cosmic ray electrons with energies greater than 50,000 ev can be estimated. Author

N71-17006# Lockheed Missiles and Space Co., Palo Alto, Calif.
STELLAR COMPONENT OF THE SKY BACKGROUND IN THE FAR ULTRAVIOLET SPECTRUM RANGE
A. S. Smirnov [1970] 10 p refs Transl. into ENGLISH from Kosmich. Issled., Akad. Nauk SSSR (Moscow), v. 8, no. 5, 1970 p 750-757
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The far ultraviolet radiation of space objects is absorbed completely by earth's atmosphere at altitudes on the order of even 100 km. Consequently, transporting the recording apparatus beyond the limits of the atmosphere on board space vehicles is necessary. Difficulties in navigation and stabilization often oblige utilization of detectors which record just the total radiation incident in the instrument's field of view, and do not permit separation of the stellar component of the radiation from the radiation of the interstellar medium, nor the resolution of the total radiation of stars into individual stars. Geiger-Muller counters or photo multipliers which record the integrated flux in the whole sensitivity band (high-resolution spectrum instruments are utilized only for spectroscopy of the sun and bright blue stars) are used as ultraviolet radiation detectors on board satellites or probes. Extraction of the stellar component from the total radiation in the far ultraviolet spectrum range would permit finding the density and spatial distribution of stars of previous spectrum classes in the galaxy. Extraction of the nonstellar component would afford a possibility of determining such parameters of the interstellar medium as the density, chemical constitution, and temperature. Author

N71-17007# Lockheed Missiles and Space Co., Palo Alto, Calif.
DETERMINATION OF THE TEMPERATURE OF THE QUIET CORONA FROM THE FLUX OF SOFT X-RADIATION
I. A. Zhitnik et al. [1970] 6 p refs Transl. into ENGLISH from Astron. Zh. USSR, v. 47, no. 4, 1970 p 702-707
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The determination of the temperature of the solar corona from the flux of soft radiation is reported. X-radiation was recorded by using an X-ray heliograph. The absolute value of the flux corresponds to the temperature in the undisturbed corona not below 1,600,000 degrees Kelvin. Author

N71-17218# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
A PROPOSAL FOR MEASURING LONG TERM VARIATIONS OF PROTON FLUXES IN THE INNER RADIATION BELT [EIN VORSCHLAG ZUR MESSUNG VON LANGZEITVARIATIONEN DER PROTONENFLUESSE IM INNEREN STRAHLUNGSGUERTEL]
B. Haeusler and D. Hovestadt Mar. 1970 34 p refs In GERMAN
(MPI-PAE/Extraterr-37) Avail: NTIS

In addition to Azur satellite experiments, a series of sounding rocket experiments is proposed carrying proton telescopes to measure inner radiation belt proton fluxes over a longer period. Possible configurations for these telescopes are discussed. ESRO

N71-17217# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
DUAL CRYSTAL TELESCOPE INVESTIGATIONS FOR X-RAY WAVELENGTHS [UNTERSUCHUNGEN ZU EINEM DOPPELKRISTALL-TELESKOP IM BEREICH DER ROENTGEN-WELLENLAENGEN]
Wolfgang M. Schmid Jul. 1969 51 p refs In GERMAN
Sponsored in part by Bundesmin. fuer Bildung und Wiss.
(MPI-PAE/Extraterr-30) Avail: NTIS

The dual-crystal telescope is based on the collimation of the incident radiation by total reflection from a single crystal in Bragg reflection. The spatial and spectral resolutions and luminous intensity of the telescope are considered and its construction, using silicon single crystals, is discussed. ESRO

N71-17780# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TURBULENT LOSS OF RING CURRENT PROTONS
John M. Cornwall, F. V. Coroniti (Calif. Univ., Los Angeles), and Richard M. Thorne (Calif. Univ., Los Angeles) 1 Nov. 1970 41 p refs
(Contract F04701-70-C-0059)
(AD-715260; TR-0059-6260-20-10; SAMSO-TR-70-406) Avail: NTIS CSCL 4/1

Ring current protons (<50 keV), which are unaffected by ion cyclotron waves outside the plasmapause, undergo strong turbulent diffusion just inside the plasmapause. Lifetimes from ion cyclotron turbulence are predicted to be of the order of one hour, as observed by Frank for 3 < or = L < or = 5. During the main phase of a geomagnetic storm, the protons rapidly diffuse across the plasmapause (probably at the Bohm rate), and are lost before reaching the noon meridian, giving rise to the asymmetric part of the ring current. During the recovery phase the ring current decays on a time scale of a day or less as the turbulent region moves outward with the expansion of the plasmapause. Further decay takes place on a charge exchange time scale. One consequence of the dissipation of ring current energy at the plasmapause should be the formation of mid-latitude red arcs, probably by the conversion of this energy into heat as the ion cyclotron waves are absorbed by electrons. Author (GRA)

N71-18035# Smithsonian Astrophysical Observatory, Cambridge, Mass.
LOW-ENERGY GAMMA RAYS IN THE ATMOSPHERE
Jerome S. Pushkin (Ph.D. Thesis – Harvard Univ.) 30 Jun. 1970 115 p refs
(Contract F19628-68-C-0297)
(AD-715271; SAO-Special-Rept-318) Avail: NTIS CSCL 4/1

The low energy (0.3 - 10 Mev) gamma ray flux at balloon altitude (3.5mb) and at medium latitude (approx 42 degrees), resulting from energetic particle interactions with atmospheric atoms, is calculated from measured particle intensity vs. depth profiles. Electron bremstrahlung is found to be the dominant source of such photons, with a substantial contribution from positron annihilation gamma rays in the 0.3 - 0.51 Mev region. The intensity of low energy atmospheric photons is found to be strongest in the upwards and sidewards directions. The energy and angular response of a typical low energy detector - 3 inch x 3 inch NaI crystal - is investigated. Finally, the response of such a dector to the atmospheric flux calculated earlier is predicted and found to be in good agreement with experiment. Author (GRA)

N71-18042# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OUTER-ZONE ELECTRON PRECIPITATION
Alfred L. Vampola, Harry C. Koons, and Donald A. McPherson 15 Aug. 1970 32 p refs
(Contract F04701-70-C-0059)
(AD-715266; TR-0059(9220-02)-5; SAMSO-TR-70-395) Avail: NTIS CSCL 4/1

Measurements of energetic electrons (300 keV to 2.3 MeV) within the drift loss cone, of ELF emissions, and of the plasmapause location obtained with instruments aboard the low-altitude, polar satellite OV3-3 (1966-70A) are compared. It is found that there is a knee in the L-shell profile of the precipitated fluxes of outer-zone electrons with the flux decreasing toward lower latitudes. The location of this knee strongly correlates with the morning location of the plasma-pause but does not correlate with the evening location of the plasmapause. It is also found that, for 3.3 = or < L = or < 4.3, electrons are preferentially precipitated in the morning hours after 6:00 local time. This corresponds to the strong morning maximum in the occurrence of whistler-mode ELF emissions. Electromagnetic ELF emissions are often observed just outside of the plasmapause where the maximum flux of precipitated electrons is observed. The experimental data suggest that the morning location of the plasmapause is the controlling factor in the low latitude decrease of outer-zone electron precipitation. Author (GRA)

N71-18052 Stanford Univ., Calif.
A MODEL FOR TYPE 3 SOLAR RADIO BURSTS
Dean Francis Smith (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-1608

Observational data concerning Type 3 solar radio bursts are reviewed briefly to list the salient requirements of a model for these bursts. The most important of these requirements is that the electron stream exciting these bursts must be stabilized after the energy in plasma waves has reached a highly nonthermal level. Previous theories of Type 3 bursts are examined to determine the extent to which they meet these requirements. It is submitted that no theory meets enough of these requirements to be acceptable. Since the requirements of a model indicate that nonlinear effects must play an essential role in the production of a Type 3 burst, the semiquantum theory of nonlinear effects in a plasma is reviewed. The analysis is confined to a plasma in the absence of a magnetic field. This theory is systematically applied to study mechanisms for stream stabilization and the emission and absorption of radiation. Dissert. Abstr.

N71-18054 Minnesota Univ., Minneapolis.
A BALLOON BORNE X-RAY SURVEY OF THE CYGNUS REGION
Charles Peter Reinert (Ph.D. Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-1815

An X-ray telescope, using a 100 sq cm area by 2.5 cm thick NaI(Tl) central detector, surrounded by a graded shield of Pb, Sn, Cu, and liquid scintillator, and using 28-channel energy discrimination, was flown from Palestine, Texas on the evening of 2 May, 1967. The experiment floated at an altitude of 4.6 gm/sq cm for 9 hours, rotating with constant azimuthal angular velocity, and fixed zenith angles of 5 degrees. Three hours of background data were recorded before the four rocket X-ray sources in Cygnus passed into view. After observing each source for approximately 2 1/2 hours, the background was again monitored for 2 hours. Good agreement was obtained between the results of this work and those of other workers who measured X-1 near 3 May 1967, lending support to the hypothesis that the source may be variable. Dissert. Abstr.

N71-18055 Utah Univ., Salt Lake City.
CHARGE RATIO OF 1-10 TeV COSMIC RAY MUONS
John Henry Parker, Jr., (Ph.D. Thesis) 1969 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-2025

The charge ratio of muons in the zenith range 40 deg to 90 deg with production energies greater than 1 TeV was determined using the kiloton neutrino detector. Approximately 90 days live time resulted in 7482 useable muons with a consolidated plus to minus ratio of 1.29 + or - 0.03. The charge ratio as a function of energy and zenith angle is shown to be consistent with a simple model in which a process of direct muon production with unity charge ratio becomes dominant above a few TeV. The data are inconsistent with muon production from pionization or from isobar decay unless some process which decreases the charge ratio at higher energies is involved. The unique design of the detector permitted a measurement of the charge ratio (0.91 + or - 0.14) of muons observed to be part of a multiple muon event and a direct measurement of the fraction (0.03 + or - 0.02) of positive muons counted as negative and vice versa, which increases the charge ratio and its error flag by a negligible amount. Dissert. Abstr.

N71-18075 New York Univ., N.Y.
THE SYNTHESIS OF THE LIGHT ELEMENTS IN SUPERNOVA EXPLOSIONS
Michael D. Delano (Ph.D. Thesis) 1969 391 p

Avail: Univ. Microfilms: HC $17.80/Microfilm $5.00 Order No. 70-3054

A nuclear reaction network of 903 different strong and electromagnetic reactions linking 107 chemical constituents has been developed to study the synthesis of the light elements in supernova explosions. Because of the many three body reactions included and the large size of the network, special techniques are derived for the numerical integration of the network equations. For the models tested, it has been found that the light elements have very little chance of surviving the explosion. During the long freeze out times, all the light constituents are consumed in the production of heavy elements. The resulting heavy material is so preponderant that there is a direct conflict between these supernova models and the element abundances observed in nature. This plus the possibly serious omission of neutrino momentum transport in the previous hydrodynamic calculations for these models casts doubts as to their validity and the validity of present day theories of supernova explosions. Dissert. Abstr.

N71-18076# Sea Farm Research Foundation, Inc., Waltham, Mass.

STUDY OF SOME ASTROPHYSICAL PROBLEMS CONCERNING PLASMA PROCESSES AND ROTATIONAL HYDRODYNAMICS Final Report, 15 Feb. 1969 – 31 Aug. 1970

John H. Frey and Stanford D. Yukon 30 Sep. 1970 87 p refs (Contract F19628-69-C-0215)

(AD-715925; AFCRL-70-0532) Avail: NTIS CSCL 3/2

Synchrotron and Cherenkov radiation below the plasma frequency from particles spiraling in a magnetoplasma have been investigated. Both the longitudinal and transverse emissivity were calculated for mildly relativistic particles with particular attention being given to radiation from resonance regions. A new and stronger inequality for the density dependence at fixed entropy of the equilibrium energy of an arbitrary collection of point particles interacting with Coulomb inverse power law forces have been derived. Calculations based upon this derivation are necessary for models of the heavy planets as well as for models of stellar structure. A dynamo mechanism for solar flare energy production at photospheric heights was investigated. A set of equations for the motions of ions and electrons located just above the photosphere was obtained which facilitates the derivation of quantitative results. The problem of two-dimensional hydrodynamics with rotation, i.e., Rossby waves in a rotating disc of incompressible fluid, was examined. Author (GRA)

N71-18150 New Hampshire Univ., Durham.

A SEARCH FOR HIGH ENERGY SOLAR NEUTRONS

David John Forrest (Ph.D. Thesis) 1969 165 p

Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 70-2079

An experiment was performed to search for a flux of solar neutrons at the earth. The detector used was a large plastic scintillator sensitive to neutrons between 20 and 120 MeV. This detector was carried three different times during 1967 and 1968, by balloon, to an atmospheric depth of ~4g/sq cm. The balloons were normally flown through sunrise and as long as possible into the day. By comparison of the day and night counting rates it was deduced that the upper limit for the continuous emission of solar neutrons at the earth is less than 0.02 neutrons/sq cm sec in the above region. If neutrons were emitted in association with any of the fifteen small flares that occurred during the flights, then the maximum flux at the earth was less than 0.04 neutrons/sq cm sec. Using a theoretical form, these results were expressed as an upper limit differential solar neutron flux at the earth. The minimum detectable flux with the present instrument is well below the predicted flux from larger flares of 5 to 50 neutrons/sq cm sec. Dissert. Abstr.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also 11 Facilities, Research and Support; and 31 Space Vehicles.

N71-16917# Joint Publications Research Service, Washington, D.C.

SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 244

15 Jan. 1971 90 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications

(JPRS-52185) Avail: NTIS

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1. ASTRONOMY p 1–3 refs (See N71-16918 07-30)
2. METEOROLOGY p 4–18 refs (See N71-16919 07-20)
3. OCEANOGRAPHY p 19–28 refs (See N71-16920 07-13)
4. TERRESTRIAL GEOPHYSICS p 29–47 refs (See N71-16921 07-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 48–80 refs (See N71-16922 07-13)
6. MISCELLANEOUS: EXPEDITION DEPARTS FOR ANTARCTICA, NEWS p 81–82 ref

N71-16918# Joint Publications Research Service, Washington, D.C.

ASTRONOMY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 244 15 Jan. 1971 p 1–3 refs (See N71-16917 07-30)

Avail: NTIS

News briefs and abstracts of articles are presented on progress in development of astronomical telescopes, radioastronomical observations of solar eclipses, and characteristics of faint meteor orbits. R.B.

N71-16955# Joint Publications Research Service, Washington, D.C.

SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 242

15 Dec. 1970 60 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications

(JPRS-51991) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1–2 refs (See N71-16956 07-30)
2. METEOROLOGY p 3–12 refs (See N71-16957 07-20)
3. OCEANOGRAPHY p 13–17 refs (See N71-16958 07-13)
4. TERRESTRIAL GEOPHYSICS p 18–24 refs (See N71-16959 07-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 25–54 refs (See N71-16960 07-13)

N71-16956# Joint Publications Research Service, Washington, D.C.

ASTRONOMY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 242 15 Dec. 1970 p 1–2 refs (See N71-16955 07-30)

Avail: NTIS

News items and research reports on: (1) operations of a stratospheric solar observatory, and (2) measurements of the mercury content in meteorites are summarized. E.C.

N71-17008# Lockheed Missiles and Space Co., Palo Alto, Calif.
METHOD OF DETERMINING ERRORS IN CONSTRUCTING THE LOCAL VERTICAL ON BOARD A SPACE VEHICLE BECAUSE OF LATITUDINAL NONUNIFORMITY IN THE EARTH'S RADIATION
A. V. Pavlov et al [1970] 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 8, no. 5, 1970 p 770–776
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The influence of the latitudinal nonuniformity in earth's radiation on the accuracy of determining the local vertical is considered. The regularity of the latitudinal change in radiation is established from data of experimental measurements on board the Cosmos-45 and Cosmos 65. The influence of the nonuniformity in the radiation on the magnitude of the error is estimated for various space vehicle flight altitudes. The latitude error depends on the magnitude of the difference in the radiation densities of the visible sections of the horizon. In turn, this latter is determined by the difference in the latitudes of the visible sections of the earth's surface. Therefore, in order to determine the magnitude of the latitude error it is necessary to know the latitude behavior of the radiation density of the earth-atmosphere system. The difference in the latitudes depends on the space vehicle flight altitude. Author

N71-17016# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
EXTRA-ATMOSPHERIC SUBMILLIMETER ASTRONOMY [VENATMOSFERNAYA SUBMILLIMETROVAYA ASTRONOMIYA]
A. Ye. Salomonovich Lexington, Mass. Lincoln Lab., MIT Mar. 1970 40 p refs Transl. into ENGLISH from USP. Fiz. Nauk (Moscow), v. 99, no. 3, 1969 p 417–438 Prepared for Lincoln Lab., MIT
(AZT-70-199-RULL) Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The history, present state and future possibilities of submillimeter astronomy are discussed. Since this area is new, the author finds great promise for new information in almost all areas of astronomy. However, to be effective, the instruments must be carried above the Earth's atmosphere to eliminate adverse atmospheric effects. Finally, several recent experiments in this area are discussed. Author

N71-17084*# Carnegie-Mellon Univ., Pittsburgh, Pa.
X-RAY DETECTION OF DISORDERED ORTHOPYROXENES IN METEORITES Final Report, 1 Jun. 1966–31 Oct. 1970
Sidney S. Pollack 1970 10 p
(Grant NGR-39-008-013)
(NASA-CR-116448) Avail: NTIS CSCL 03B

Summaries of the work using X-ray techniques for studying disordered orthopyroxenes in meteorites are presented. The tables presented include: quantitative analysis of olivine, olivine content and mole percentage of fosterite in chondrites, olivine and fosterite content in oceanic basalt and terrestrial rock. F.O.S.

N71-17073# Lockheed Missiles and Space Co., Palo Alto, Calif.
SOVIET INTERPLANETARY PROBE ON THE SURFACE OF VENUS
[1970] 9 p Transl. into ENGLISH from Pravda (Moscow), no. 27(19170), 27 Jan. 1971
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The results of the VENERA 7 space probe which landed on the surface of the planet Venus are presented. It was determined that the Venus atmosphere consists of 97 percent carbon dioxide, not more than 2 percent nitrogen, approximately 1 percent water vapor near the clouds, and not more than 0.1 percent oxygen. From previously obtained data, it is estimated that the surface temperature is on the order of 500 degrees Centigrade and the atmospheric pressure is on the order of 100 times Earth atmosphere. Author

N71-17074# Lockheed Missiles and Space Co., Palo Alto, Calif.
SUN BUREAU ON THE MOON
S. Vernov et al [1970] 4 p Transl. into ENGLISH from Pravada (Moscow), no. 323(19101), 19 Nov. 1970
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The use of lunar observatories for the study of cosmic rays is discussed. The establishment of lunar scientific laboratories will permit solutions to the problems of solar radiation, extraterrestrial radiation, and space communication. Such an installation will assure continuous observation of the sun and the interplanetary medium at diverse points in the solar system. Author

N71-17218# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.
EFFECTS OF MICROMETEOROIDS ON OPTICAL SURFACES [EFFETS DES MICROMETEORIDES SUR DES SURFACES OPTIQUES]
J.-C. Mandeville Aug. 1970 37 p refs In FRENCH
(ONERA-DERTS-NT-01-12) Avail: NTIS

The effects of micrometeoroids on mirror reflectance were simulated using an electrostatic accelerator to bombard mirrors with small iron particles (1 micron diameter) and varying their rate, size, and velocity. Data on the loss of reflectance in the visible and the infrared are presented and similar effects in space are evaluated. ESRO

N71-17219# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
ON THE DETERMINATION OF PERIODIC SOLUTIONS OF ORBITAL PROBLEMS [ZUR BESTIMMUNG GANZPERIODISCHER LOESUNGEN IN BEWEGUNGSPROBLEMEN]
M. Schneider Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Oct. 1970 49 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-52) Avail: NTIS; ZLDI Munich: 9.80 DM

The problem of determining periodic solutions in celestial mechanics is formulated as an integral equation and solved using Hammerstein's method. These procedures are applied to several well known problems in celestial mechanics. Author (ESRO)

N71-17335*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MICROMETEORITE CRATERS AND RELATED FEATURES ON LUNAR ROCK SURFACES
Friedrich Hoerz (Lunar Sci. Inst.), Jack B. Hartung, and Donald E. Gault (NASA. Ames Res. Center) 1970 19 p refs Prepared by Lunar Sci. Inst.
(Contract NSR-09-012-071)
(NASA-TM-X-66705; LSI-3) Avail: NTIS CSCL 03B

Craters in the .4 to 10 mm size class were observed on six Apollo 12 whole rock surfaces. Craters on crystalline surfaces are characterized by a central, glass-lined cavity, a concentric zone of shock fractured, high albedo material and a concentric spallation area. The crater geometries observed are similar to craters produced in the laboratory with projectile velocities exceeding 10 Km/sec.

The high projectile velocities required and the presence of a distinct demarcation line between cratered and uncratered surfaces on individual rocks indicate that most of the microcraters are produced by primary cosmic particles. These discrete impact events account for most of the erosion and fragmentation of lunar surface rocks. Author

N71-17336*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MEETING: METEORITE IMPACT AND VOLCANISM
F. Hoerz (Lunar Sci Inst.) and T. H. Foss 1970 5 p Meeting held in Houston, Tex., 19–23 Oct. 1970; sponsored by Univ. Space Res. Assoc. Prepared by Lunar Sci. Inst.
(Contract NSR-09-012-071)
(NASA-TM-X-66706; LSI-18) Avail: NTIS CSCL 03B

Structural aspects of impact craters such as formation of detailed rim structures and intense macro deformation of rocks are discussed. The ejecta blankets around natural and artificial impact sites, as well as those around nuclear and large scale chemical and nuclear explosion craters display concentric distribution patterns and inverted stratigraphy. The formation mechanism of central uplifts in impact craters remains controversial. It is postulated that such structures are formed immediately after crater excavation either by gravitational slumping of the crater walls pushing the crater bottom upwards or as a rebound phenomenon closely associated with pressure release. Author

N71-17486# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 245
28 Jan. 1971 115 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications
(JPRS-52276) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1–6 refs (See N71-17487 07-30)
2. METEOROLOGY p 7–24 refs (See N71-17488 07-20)
3. OCEANOGRAPHY p 25–40 refs (See N71-17489 07-13)
4. TERRESTRIAL GEOPHYSICS p 41–65 refs (See N71-17490 07-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 66–97 refs (See N71-17491 07-13)
6. SUPPLEMENT: WORK OF THE UNDERWATER RESEARCH LABORATORY p 98–105 (See N71-17492 07-13)

N71-17487# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 245 28 Jan. 1971 p 1–6 refs (See N71-17486 07-30)
Avail: NTIS

News items and research reports on the following topics are summarized: physical properties of lunar surface samples, ring shaped structures on the earth and other planets, hypotheses of star formation, radio emission of Crab nebula and some quasars at 8.2mm and 3.36cm, effective thickness of lunar radioactive layer, emission stability of the radio source Cassiopeia A in the decameter wavelength range, and galactic and metagalactic components of distributed cosmic radio emissions. E.C.

N71-17496*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF TRAJECTORY PROFILES AND NUCLEAR-PROPULSION-MODULE ARRANGEMENTS FOR MANNED MARS AND MARS-VENUS MISSIONS
Edward A. Willis, Jr. Washington Feb. 1971 30 p refs
(NASA-TN-D-6176; E-5854) Avail: NTIS CSCL 22C

A brief comparison is made between opposition class (with three impulse return), conjunction class, Venus swing-by to Mars and Mars-Venus double stopover trajectories. Vehicle configurations based on NERVA-I engines of varying life and restart capability are considered. It is found that the opposition and Venus swingby trajectories to Mars yield competitive mission performance; the double stopover entails about 30-percent penalties in initial mass and trip time; and that the minimum-weight vehicle uses a single, restartable engine. Author

N71-17497*# Geological Survey, Washington, D.C.
GEOLOGIC MAPS OF EARLY APOLLO LANDING SITES OF SET C
N. J. Trask Oct. 1969 31 p refs *Its* Interagency Report: Astrogeology-17
(NASA Order T-66353-G)
(NASA-CR-116408) Avail: NTIS CSCL 03B

Comparison of the five potential early Apollo landing sites of set C reveals significant geologic similarities and differences. No two sites are identical; the geology of each should be considered in the interpretation of returned lunar samples and observations. Geologic maps of each site have been prepared at scales of 1:5,000, 1:25,000, and 1:100,000. Features emphasized on the 1:5,000-scale maps are common to all the sites and include mainly the widespread lunar regolith and small craters of varied age and origin. Because they cover the lunar surface and because mobility will be limited on early missions, these ubiquitous features will be the main objects of scientific inquiry during the first manned landings. Author

N71-17498*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MICROMETEORITE CRATERS ON LUNAR ROCK SURFACES
F. Hoerz (Lunar Science Inst.), J. B. Hartung, and D. E. Gault (NASA, Ames Research Center) 1970 80 p refs *Its* Lunar Sci. Inst. Contrib. No. 09
(Contract NSR-09-012-071)
(NASA-TM-X-66707) Avail: NTIS CSCL 03B

Detailed optical stereomicroscope study of seven lunar rocks has been made. Common microcraters on crystalline rock surfaces consist of a central glass-lined pit surrounded by a crush-zone or halo of microfractured crystalline material both of which lie within a spall area produced by the impact event. Based on laboratory cratering experiments which yield glass-lined pits, at least 95% of the microcraters observed are interpreted as the impacts of primary cosmic particles moving at relative velocities greater than 10 km/sec. The mean survival times of the seven rocks are calculated to 5-3.5 million years using empirical data on rock destruction by meteroid impact. A similar approach is used to derive a minimum erosion rate of .2 – .4 mm in 1 million years. However all these data are heavily dependent on the interplanetary particle flux applied and thus highly tentative. Author

N71-17499*# Bellcomm, Inc., Washington, D.C.
SIMPLE MASS DISTRIBUTION FOR THE LUNAR POTENTIAL
S. L. Levie, Jr. 1 Feb. 1971 19 p refs
(Contract NASw-417)
(NASA-CR-116507; TM-71-2014-2) Avail: NTIS CSCL 03B

A set of twenty-one point masses gravitationally equivalent to the L1 lunar potential model is presented. By construction, the equivalence is valid only in a region of space sampled by Apollo spacecraft. That region is taken to be a finite, torus-shaped shell. When used in place of the L1 model for Apollo 12 lunar orbit

determination, the solution set gives spacecraft positions identical to within about 300 feet. The solution is developed in two steps: first the L1 potential is examined to determine favorable mass locations, and then the mass values are computed to force an optimum matching of the L1 potential. Therefore the solution set is artificial. It is related to the moon's actual mass distribution only in its similar gravitational effects in a limited region of space. Author

N71-17525*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
METEOROID ENVIRONMENT MODEL, 1970: INTERPLANETARY AND PLANETARY. NASA SPACE VEHICLE DESIGN CRITERIA (ENVIRONMENT)
D. J. Kessler Oct. 1970 69 p refs
(NASA-SP-8038) Avail: NTIS CSCL 03B

Defined is the meteoroid environment from 0.1 to 30.0 astronomical units (AU) outward from the sun in the mass range between 10 to the minus 12th power and 10 to the 2nd power grams. A detailed model of this environment is presented as number of particles per unit volume as a function of mass together with velocity curves. This model is to be used in the design of space vehicles which will travel in interplanetary space or will orbit planets. Also given is a simplified model and sample applications of both models to a space vehicle mission. Author

N71-17556*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
PHYSICAL PROPERTIES OF THE APOLLO 12 LUNAR FINES
T. Gold, B. T. O'Leary, and M. Campbell Jan. 1971 21 p refs Presented at the Lunar Sci. Conf., Houston, Tex., 11–14 Jan. 1971
(Contract NAS9-8018)
(NASA-CR-114844; CRSR-418) Avail: NTIS CSCL 03B

The physical properties of the lunar soil samples of Apollo 12 are compared to those of the Apollo 11. The properties studied were: grain size, dielectric constant, and optical. The results are graphed. F.O.S.

N71-17557*# California Univ., Berkeley. Space Sciences Lab.
PARTICLE DETECTOR STUDIES ON LUNAR ORBITAL MISSIONS Final Report, 30 Jun. 1969–30 Jun. 1970
K. A. Anderson 14 Dec. 1970 61 p *Its* SSL Ser. 11, Issue 84
(Contract NAS9-9895)
(NASA-CR-114858) Avail: NTIS CSCL 03B

A set of electrostatic analyzers and solid state detectors were tested to determine their suitability for use on Apollo lunar orbital missions. The electrostatic analyzers were required to have high sensitivity to the low fluxes of energetic solar electrons while at the same time they were required to reject large fluxes of solar ultraviolet. To obtain high electron sensitivity, five funnel-mouthed continuous channel electron multipliers were used in parallel. To reject ultraviolet the electrode plates were serrated and coated with gold black. This procedure reduced ultraviolet intensity reaching the detectors by 12 orders of magnitude. The solid state detectors were required to have low electron energy threshold, high resolution and low noise counting rate. Results show that a lithium drift detector can be used for electrons with energies as low as 5.9 keV. Author

N71-17559*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
EVOLUTION OF MARE SURFACE
T. Gold Jan. 1971 6 p refs Presented at Lunar Sci. Conf., Houston, Tex., Jan. 1971
(Contract NAS9-8018)
(NASA-CR-114845; CRSR-422) Avail: NTIS CSCL 03B

Photography of the lunar surface from orbit shows in general an absence of stratification on most steep surfaces. Almost everywhere the material seems to be very homogeneous to a depth of several kilometers. Craters are frequently very precisely circular and bowl shaped. The cases where there are ledges or particularly densely strewn boulder fields around craters may be a local exception, or they may represent a compaction and induration of the lunar soil with depth. There is no evidence that anything other than lunar soil, differently compacted and cemented in different locations, fills all the mare basins. The seismic evidence cannot be understood except with an absence of widespread bedrock at shallow depth, and instead, the presence of a medium of much slower sonic velocity over an interval of several kilometers of depth. Lunar soil gradually compacted with depth would account very well for the whole range of seismic phenomena seen. Author

N71-17561*# Smithsonian Institution, Washington, D.C. Dept. of Mineral Sciences.
MINERALOGY AND PETROGRAPHY OF SOME APOLLO 12 SAMPLES Final Report
Brian Mason [1970] 13 p refs
(Contract NAS9-8016)
(NASA-CR-114840) Avail: NTIS CSCL 03B

The mineralogy and petrography of lunar soil samples returned by the Apollo 12 flight are discussed. The lunar samples contain fragments of crystalline rocks and breccias, mineral grains, and glassy particles. The mineral grains are mainly pyroxenes (pigeonite and augite) and olivine, with minor amounts of plagioclase and ilmenite, and rare metal grains. The compositions of the metal grains indicate that some are of meteroritic origin and some are derived from lunar rocks. Author

N71-17563*# Mobil Research and Development Corp., Dallas. Field Research Lab.
LUMINESCENCE PETROGRAPHY OF THE APOLLO 12 ROCKS AND COMPARATIVE FEATURES IN TERRESTRIAL ROCKS AND METEORITES Final Report
R. F. Sippel 28 Jan. 1971 32 p refs
(Contract NAS9-9673)
(NASA-CR-114842) Avail: NTIS CSCL 03B

The Apollo-12 igneous rocks studied (12018, 21, 39, 65) are basaltic and gabbroic rocks similar to the Tranquility Base specimens although they show striking minor differences. True gabbroic grain size is found in several specimens, and these contain abundant brilliantly luminescent tridymite laths. The luminescent phases are, by volume, plagioclase, tridymite, cristobalite, quartz, and apatite. The plagioclase (anorthite and bytownite) luminescence spectra show a minor though definite red-infrared emission band in dull luminescing rims or regions. Brighter yellowish luminescing regions show spectra like those of Apollo-11 plagioclase, and consist of blue and green emission bands only. Plagioclase spectra from eucrite and howardite meteorites also lack the red-infrared band. Two silica assemblages are found: tridymite cristobalite in coarse rocks and cristobalite quartz in finer-grained rocks. Evidences of shock damage are rare in the soil fragments studied, and it appears that these lunar soil materials may have been subjected to less shock damage than the Apollo 11 specimens. Author

N71-17564*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
SINGULAR PERTURBATIONS AND MINIMUM FUEL SPACE TRAJECTORIES
T. N. Edelbaum Oct. 1970 15 p refs Presented at the Spec. Session on Singular Perturbations in System Theory at the 8th Ann. Allerton Conf. on Circuit and System Theory, Monticello, Ill., 8 Oct. 1970
(Contract NAS9-10386)
(NASA-CR-114836; E-2541) Avail: NTIS CSCL 22A

A number of examples are given of the use of singular perturbation theory in space trajectory optimization. Singular perturbation problems have resulted from the use of four different small parameters. These parameters are: (1) the mass of the launch, target, or swingby planet; (2) the reciprocal of the thrust for high thrust rockets; (3) the thrust for low thrust rockets; and (4) the reciprocal of the transfer time. Author

N71-17565*# Naval Ordnance Lab., White Oak, Md.
NEUTRON DIFFRACTION STUDY OF LUNAR MATERIALS
Final Report
S. J. Pickart and H. A. Alperin 29 Jan. 1971 25 p refs
(NASA Order T-90270)
(NASA-CR-114853) Avail: NTIS CSCL 03B

Three Apollo 12 lunar samples (12070(119), 12071(8), and 12008(7)), in the form of fines and chips, were investigated by means of neutron diffraction at room temperature, 77 K and 4.2 K. The primary purposes of the investigation, namely determination of the magnetic structure of ilmenite and the structure of glasses, could not be fulfilled because of the absence of observable quantities of FeTiO3 and glassy material in the samples provided. Nevertheless, in sample 12071(6) a possible magnetic ordering was discovered; in addition, the observed d-spacings in the samples are tabulated and correlated with possible constituent phases. Author

N71-17567*# Hughes Aircraft Co., El Segundo, Calif. Materials Technology Dept.
SURVEYOR 3 PARTS AND MATERIALS RETURNED FROM THE MOON BY APOLLO 12: EVALUATION OF LUNAR EFFECTS
22 Jan. 1971 207 p refs
(Contract NAS9-10492)
(NASA-CR-114855) Avail: NTIS CSCL 22A

The parts include the scoop from the soil mechanics/surface sampler; a section of television camera cabling; and sections of support aluminum tubing (polished, as well as painted with white inorganic paint). These parts resided on the moon 2-1/2 years prior to their recovery. Tests were conducted to determine the effects of this exposure to the lunar environment. It was determined that all of the parts withstood the environment exceedingly well. The major effect was the discoloration of surfaces, which was determined to be attributable to the combined effect of radiation damage and coating with lunar dust. No major changes in physical properties occurred, and no effects of cold welding were noted. The performance of the scoop motor was nominal. Author

N71-17670 Yale Univ., New Haven, Conn.
PROPERTIES OF THE INTERPLANETARY MEDIUM FROM SCINTILLATIONS IN JOVIAN DECAMETER EMISSION
Louis Peter Pataki, Jr. (Ph.D. Thesis) 1969 230 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 70-2786

Observations of the second-long amplitude pulses in Jupiter's decameter radio emission at a frequency of 22.2 MHz are presented and discussed. Measurements of the spatial correlation properties of the pulses along three baselines made possible a direct calculation of the correlation properties of the radiation across the observing plane. The source of the amplitude fluctuations is a diffraction phenomenon in the interplanetary medium, and the observations show that the scintillations arise in localized streams of enhanced density in the solar wind. While these streams consist of irregularities moving radially outward from the sun, solar rotation gives them a spiral appearance. The irregularities which make up the diffracting screen are generally elongated. They have a scale of hundreds of kilometers, and move radially from the sun at velocities of some hundreds of kilometers per second. Dissert. Abstr.

N71-17671 California Univ., Los Angeles.
LOWER MASS LIMIT TO THE MAIN SEQUENCE
William Charles Straka (Ph.D. Thesis) 1969 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-2263

The theoretical lower mass limit to the Main Squence has been determined, using three variations of physical parameters in the envelopes of the models. The limiting mass obtained is found to be less sensitive to a change in opacity than to a change in the ratio of mixing length to scale height. The position of the models in the H-R diagram is found also to be less sensitive to changes in opasity than to a change in the ratio of mixing length to scale height. By use of the Cox opacity tables and the Aller composition, with the mixing length equal to the scale height, the critical mass is found to be 0.082 solar masses. Use of the Auman opacities including water vapor in place of the Cox opacities in the envelope results in an increase in the opacity at the photosphere of a factor of approximately 3, and results in a lower mass limit of 0.081 solar masses. Use of the Auman opacities, with an increase of the mixing length to twice the scale height, increases the lower mass limit to 0.089 solar masses. Dissert. Abstr.

N71-17672 Yale Univ., New Haven, Conn.
A DISCUSSION OF 1960–1968 OCCULTATIONS OF STARS BY THE MOON
Thomas Charles Van Flandern (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-2825

Occultation observations during one nodal period of the Moon are analyzed utilizing atomic time, Watts limb corrections, an improved lunar theory, star positions on the FK4 system, and analytical partial derivatives in the observational equations. Corrections are derived to lunar orbital elements and to other astronomical constants. In all, 26 parameters are solved. Two somewhat tentative conclusions of this discussion are a correction of −10 seconds of arc per century squared to the secular acceleration of the Moon's mean longitude; and a difference of perhaps 2 seconds of arc along the Moon's orbit between its geometrical center and its center of mass. A more certain conclusion is that the Watts limb correction datum is slightly elliptical, the amplitude of the ellipticity being about 0.10 seconds of arc. Dissert. Abstr.

N71-17673 Yale Univ., New Haven, Conn.
STABILIZATION OF FINITE DIFFERENCE METHODS OF NUMERICAL INTEGRATION IN CELESTIAL MECHANICS
Dale Gaylord Bettis (Ph.D. Thesis) 1969 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-2893

Classical finite difference methods of numerical integration of differential equations, such as the Adams–Bashforth and the Adams–Moulton methods for differential equations of the first order, and the Cowell and the Stormer methods for differential equations of the second order, are based on polynomial approximations, and therefore integrate polynomials of a particular order exactly. When these methods are applied to differential equations of celestial mechanics, which ordinarily have solutions which are not polynomials, numerical instabilities result. Specifically, if one of the classical methods of fourth or higher order is employed for the integration of circular Keplerian motion, the resulting points spiral away from the circular orbit. In order to remove this instability from the Cowell method, a basic theory for modifying the Cowell equations such that they will perform exact integration of pure Keplerian motion were developed. Dissert. Abstr.

N71-17708# Smithsonian Institution, Washington, D.C.
MINOR AND TRACE ELEMENTS IN METEORITIC MINERALS
Brian Mason and A. L. Graham (Australian Natl. Univ.) 1970 19 p refs *Its* Smithsonian Contrib. to the Earth Sci. No. 3, 1970
Avail: SOD $0.30

Nickel-iron, troilite, olivine, pyroxenes, plagioclase, chromite, and phosphate minerals (chlorapatite and/or merrillite) were separated from meteorites (Modoc, St. Severin, Winona, Harsiya, Marjalahti, Springwater, Johnstown, Mt. Egerton, Soroti) and analyzed for minor and trace elements with a spark-source mass spectrometer. The elements Ni, Co, Ge, As, Ru, Rh, Pd, Sn, Sb, W, Re, Os, Ir, Pt, and Au are concentrated in nickel-iron; Se and Ag in troilite; Th, U, and the lanthanides in the phosphate minerals and in diopside; Eu, Sr, Ba, Rb, and Cs in plagioclase. Molybdenum and tellurium are concentrated in nickel-iron and troilite. The elements Ti, Sc, V, Cu, Zn, Mn, and Ga are distributed over several coexisting minerals. Author

N71-17709*# Kentucky Univ., Lexington. Dept. of Chemistry.
ELEMENTAL ANALYSES OF LUNAR SAMPLES BY 14 MeV AND THERMAL NEUTRON ACTIVATION Final Report, Period Ending 31 Jan. 1971
William D. Ehmann and John W. Morgan 31 Jan. 1971 73 p refs
(Contract NAS9-8017)
(NASA-CR-114841) Avail: NTIS CSCL 03B

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1. MAJOR ELEMENT ABUNDANCES IN APOLLO 12 ROCKS AND FINES BY 14 MeV NEUTRON ACTIVATION W. D. Ehmann and J. W. Morgan 16 p refs (See N71-17710 07-30)
2. LUNAR ROCK 12013: O, Si, Al AND Fe ABUNDANCES J. W. Morgan and W. D. Ehmann 6 p refs (See N71-17711 07-30)
3. OXYGEN, SILICON, AND ALUMINUM IN LUNAR SAMPLES BY 14 MeV NEUTRON ACTIVATION 3 p refs (See N71-17712 07-30)
4. OXYGEN, SILICON AND ALUMINUM IN APOLLO 11 ROCKS AND FINES BY 14 MeV NEUTRON ACTIVATION 9 p refs (See N71-17713 07-30)
5. ELEMENTAL ABUNDANCES BY INSTRUMENTAL ACTIVATION ANALYSES IN CHIPS FROM 27 LUNAR ROCKS G. G. Goles, K. Randle, M. Osawa (Oregon Univ., Eugene), R. A. Schmitt (Oregon State Univ.), W. D. Ehmann et al 12 p refs (See N71-17714 07-30)
6. INSTRUMENTAL ACTIVATION TECHNIQUES FOR THE ANALYSIS OF METEORITES AND LUNAR MATERIALS J. W. Morgan and W. D. Ehmann 9 p refs (See N71-17715 07-30)
7. PRECISE DETERMINATION OF OXYGEN AND SILICON IN CHONDRITIC METEORITES BY 14 MeV NEUTRON ACTIVATION WITH A SINGLE TRANSFER SYSTEM J. W. Morgan and W. D. Ehmann 14 p refs (See N71-17716 07-30)

N71-17710*# Kentucky Univ., Lexington. Dept. of Chemistry.
MAJOR ELEMENT ABUNDANCES IN APOLLO 12 ROCKS AND FINES BY 14 MeV NEUTRON ACTIVATION
William D. Ehmann and John W. Morgan *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 16 p refs Presented at 2d Lunar Sci. Conf., Houston, Tex., 11 Jan. 1971 (See N71-17709 07-30)
Avail: NTIS CSCL 03B

Abundances of O, Si, Al, Mg, and Fe in seven rocks and four samples of fines collected by the Apollo 12 mission were determined by instrumental 14 MeV neutron activation. These five elements constitute approximately 90% of the mass of these materials. The abundances for Type A, Type AB, Type B, and Type D, respectively, are: O 39.3, 39.4, 40.4, 42.0%; Si 20.7, 21.2, 21.4, 23.0%; Al 4.3, 5.1, 4.8, 6.7%; Mg 6.9, 4.5, 4.5 to 10.1, 6.6% and Fe 15.5, 14.7, 15.1, 12.6%. These and separately published results on five chips derived from rock 12013 are discussed and compared to the results obtained on the Apollo 11 materials. Author

N71-17711*# Kentucky Univ., Lexington. Dept. of Chemistry.
LUNAR ROCK 12013: O, Si, Al and Fe ABUNDANCES
John W. Morgan and William D. Ehmann *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 6 p refs Repr. from Earth Planet. Sci. Lett. (Netherlands), v. 9, 1970 p 164–168 (See N71-17709 07-30)
Avail: NTIS CSCL 03B

The abundances of O,Si,Al, and Fe were determined by 14 MeV neutron activation analysis in 5 chips and 3 powders derived from Apollo 12 lunar rock 12013. These four elements constitute approximately 90% of the mass of this rock. Mass weighted mean abundances in weight per cent for the five chips where contamination problems are expected to be minimal are: O:45.2%, Si:28.4%, Al:6.5%, and Fe:10%. A significant positive correlation was observed for Si and O abundances in the chips and a linear regression line drawn through these data passes close to the mean for the Apollo 11 breccias. A significant negative correlation was observed for Al with Si in the chips. Author

N71-17712*# Kentucky Univ., Lexington.
OXYGEN, SILICON AND ALUMINUM IN LUNAR SAMPLES BY 14 MeV NEUTRON ACTIVATION
William D. Ehmann and John W. Morgan *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 3 p refs Repr. from Science, v. 167, 30 Jan. 1970 p 528–530 (See N71-17709 07-30)
Avail: NTIS CSCL 03B

Abundances of oxygen, silicon, and aluminum in 27 lunar rocks and caliquants of lunar soil were determined by 14 MeV neutron activation. Mean abundances and standard deviations of individual abundances within each type are given. Oxygen abundances are lower than those in most common terrestrial rocks and are comparable to those found in certain types of stony meteorites. From these results the lunar soil is most similar to the type C lunar rocks. Author

N71-17713*# Kentucky Univ., Lexington. Dept. of Chemistry.
OXYGEN, SILICON AND ALUMINUM IN APOLLO 11 ROCKS AND FINES BY 14 MeV NEUTRON ACTIVATION
William D. Ehmann and John W. Morgan *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 9 p refs Repr. From Geochim. Cosmochim. Acta (London), v. 2, 1970 p 1071–1079 (See N71-17709 07-30)
Avail: NTIS CSCL 03B

Fast neutron activation analysis of Apollo 11 lunar material yielded: Type A (2 rocks) 38.5% O, 18.9% Si, 4.0% Al; Type B (7 rocks) 39.4% O, 18.7% Si, 5.0% Al; Type C (18 rocks) 41.1% O, 19.7% Si, 6.6% Al; Type D (3 aliquants) 40.8% O, 20.2% Si, 7.2% Al and 12.4% Fe. The crystalline rocks (Types A and B) can be put into two distinct chemical groups on the basis of Al contents. The fines and breccias are significantly higher in O, Si, and Al than the crystalline rocks. An apparent deficiency in the fines about 1% O may be due to reduction by solar wind H. Author

N71-17714*# Kentucky Univ., Lexington. Dept. of Chemistry.
ELEMENTAL ABUNDANCES BY INSTRUMENTAL ACTIVATION ANALYSIS IN CHIPS FROM 27 LUNAR ROCKS
Gordon G. Goles (Oregon Univ., Eugene), Keith Randle (Oregon Univ., Eugene), Masumi Osawa (Oregon Univ., Eugene), Roman A. Schmitt (Oregon State Univ.), Hiroshi Wakita (Oregon State Univ.) et al *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 12 p refs Repr. from Geochim. Cosmochim. Acta (London), v. 2, 1970 p 1165–1176 (See N71-17709 07-30)
(Contracts NAS9-7961; NAS9-8097; Grants NGL-38-003-010; NGR-38-002-020; NSF GA-1383)
Avail: NTIS CSCL 03B

Analyses of 27 chips from lunar rocks by instrumental activation techniques provided data on Si, Ti, Al, Fe, Mg, Ca, O, Na, Ba, La, Ce, Sm, Eu, Tb, Ho, Yb, Lu, U, Zr, Hf, Ta, Mn, Cu, Co, Sc, V and Cr. These abundances may be used to comment on the merits of analytical methods and survey geochemical characteristics of Apollo 11 rocks. On compositional grounds, rocks 10024 and 10071 should be classified as basalts rather than as microgabbros. The microgabbro 10050 is compositionally anomalous, with low Fe (in which it resembles breccias), about 6.5% Mg, and low La and Hf contents. It may be a specimen from a geologic unit distinct from that on which Eagle landed. Breccia 10056 is also compositionally anomalous, but it resembles microgabbros 10047 closely enough so as not to be explained by exotic provenance.
Author

N71-17715*# Kentucky Univ., Lexington. Dept. of Chemistry.
INSTRUMENTAL ACTIVATION TECHNIQUES FOR THE ANALYSIS OF METEORITES AND LUNAR MATERIALS
John W. Morgan and William D. Ehmann *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 9 p refs Repr. from Amer. Lab., Sep. 1970 p 19–31 Presented at Pittsburgh Conf. on Anal. Chem. and Appl. Spectry., Cleveland, 3 Mar. 1970 (See N71-17709 07-30)
(Contract AT(40-1)-2670)
Avail: NTIS CSCL 03B

The principles of non-destructive activation analysis methods that can be applied to meteoritic and lunar material are summarized.
Author

N71-17716*# Kentucky Univ., Lexington. Dept. of Chemistry.
PRECISE DETERMINATION OF OXYGEN AND SILICON IN CHONDRITIC METEORITES BY 14 MeV NEUTRON ACTIVATION WITH A SINGLE TRANSFER SYSTEM
John W. Morgan and William D. Ehmann *In its* Elemental Analyses of Lunar Samples by 14 MeV and Thermal Neutron Activation 31 Jan. 1971 14 p refs Repr. from Anal. Chim. Acta (Netherlands), v. 49, 1970 p 287–299 (See N71-17709 07-30)
Avail: NTIS CSCL 03B

Improved methods for the determination of oxygen and silicon by 14 MeV neutron activation are described. A single transfer system is used to attain a precision approaching that of biaxial rotator systems. Analyses of six samples of the Allende chrondrite are given and a correlation is found between oxygen and silicon abundances.
Author

N71-17717*# California Univ., Los Angeles. Dept. of Geology.
MICROPALEONTOLOGICAL STUDIES OF LUNAR SAMPLES. A SEARCH FOR BIOGENIC STRUCTURES IN THE APOLLO 12 LUNAR SAMPLES
J. William Schopf Jan. 1971 37 p refs
(Contract NAS9-9941)
(NASA-CR-114839) Avail: NTIS CSCL 03B

CONTENTS:

1. A SEARCH FOR BIOGENIC STRUCTURES IN THE APOLLO 12 LUNAR SAMPLES J. W. Schopf 9 p refs (See N71-17718 07-30)

2. MICROPALEONTOLOGICAL STUDIES OF LUNAR SAMPLES J. W. Schopf 2 p refs (See N71-17719 07-30)

3. SEARCH FOR ORGANIC COMPOUNDS IN THE LUNAR DUST FROM THE SEA OF TRANQUILLITY C. Ponnamperuma, K. Kvenvolden, S. Chang, R. Johnson (NASA, Ames Res. Center), C. Gehrke (Missouri Univ., Columbia) et al 4 p refs (See N71-17720 07-30)

4. MICROPALEONTOLOGICAL STUDIES OF APOLLO 11 LUNAR SAMPLES J. W. Schopf 2 p refs (See N71-17721 07-30)

5. EXTRACTABLE ORGANIC MATTER IN PRECAMBRIAN CHERTS J. W. Smith, J. W. Schopf, and I. R. Kaplan 18 p refs (See N71-17722 07-13)

N71-17718*# California Univ., Los Angeles.
A SEARCH FOR BIOGENIC STRUCTURES IN THE APOLLO 12 LUNAR SAMPLES
J. William Schopf *In its* Micropaleontological Studies of Lunar Samples Jan. 1971 9 p refs (See N71-17717 07-30)
Avail: NTIS CSCL 03B

Optical and electron microscopic studies of rock chips and dust returned by Apollo 12, and of a petrographic thin section of microbreccia have yielded no evidence of lunar organisms. Terrestrial contamination of these samples by particulate organic matter is less than that typical of Apollo 11 samples.
Author

N71-17719*# California Univ., Los Angeles. Dept. of Geology.
MICROPALEONTOLOGICAL STUDIES OF LUNAR SAMPLES
J. William Schopf *In its* Micropaleontological Studies of Lunar Samples Jan. 1971 2 p refs Repr. from Science, v. 167, Jan. 1970 p 779–780 (See N71-17717 07-30)
Avail: NTIS CSCL 03B

Optical and electron microscopic studies of rock chips and dust from the bulk sample box returned by Apollo 11 and of petrographic thin sections and acid resistant residues of lunar materials have yielded no evidence of indigenous biological activity.
Author

N71-17720*# California Univ., Los Angeles.
SEARCH FOR ORGANIC COMPOUNDS IN THE LUNAR DUST FROM THE SEA OF TRANQUILITY
Isaac Kaplan, John Smith, J. William Schopf, Cyril Ponnamperuma (NASA, Ames Res. Center), Keith Kvenvolden (NASA, Ames Res. Center) et al *In its* Micropaleontological Studies of Lunar Samples Jan. 1971 4 p refs Repr. from Science, v. 167, Jan. 1970 p 760–762 (See N71-17717 07-30)
Avail: NTIS CSCL 03B

A sample of lunar dust was examined for organic compounds. Carbon detected in concentrations of 157 micrograms per gram had a delta C-13 per mil (PDB) value of +20. Treatment with hydrochloric acid yielded hydrocarbons of low molecular weight, suggesting the presence of carbides. The gas chromatogram of the acylated and esterfied derivatives of the hydrolyzate was similar to that obtained for the Pueblito de Allende meteorite. There were no detectable amounts of extractable high molecular weight alkanes, aromatic hydrocarbons, isoprenoid hydrocarbons, normal alkanes, fatty acids, amino acids, sugars, or nucleic acid bases. Traces of porphyrins were found, perhaps arising from rocket exhaust materials.
Author

N71-17721*# California Univ., Los Angeles. Dept. of Geology.
MICROPALEONTOLOGICAL STUDIES OF APOLLO 11 LUNAR SAMPLES

J. William Schopf *In its* Micropaleontological Studies of Lunar Samples Jan. 1971 2 p refs Repr. from Proc. of the Apollo 11 Lunar Sci. Conf., v. 2 p 1933–1934 (See N71-17717 07-30)
Avail: NTIS CSCL 03B

Optical and electron microscopic studies of rock chips and dust returned by Apollo 11, and of petrographic thin sections and acid resistant residues of lunar materials, have yielded no evidence of indigenous biological activities. Author

N71-17735*# General Electric Co., Schenectady, N.Y. General Physics Lab.
INVESTIGATIONS OF LUNAR MATERIALS Final Report
G. M. Comstock, A. O. Evwaraye, R. L. Fleischer, and H. R. Hart, Jr. 25 Jan. 1971 15 p refs
(Contract NAS9-7898)
(NASA-CR-114843) Avail: NTIS CSCL 03B

The erosion of lunar rocks is estimated by comparing the cosmic ray track distributions in lunar rocks with the one found in (uneroded) glass detectors exposed in Surveyor 3. Erosion at a rate of about one atomic layer per year is inferred. By inducing uranium-235 fission tracks, uranium concentrations were measured. The fossil track abundance in the zircon gives no evidence for the presence of extinct radioactivity by plutonium-244 or by super heavy nuclei. Deformation-produced track erasure was seen in some soil grains. Author

N71-17788* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OMNI-DIRECTIONAL ANISOTROPIC MOLECULAR TRAP Patent
Harold Shapiro and William F. Hardgrove, inventors (to NASA) Issued 22 Nov. 1966 (Filed 3 Jun. 1964) 5 p Cl. 73-432
(NASA-Case-XGS-00783; US-Patent-3,286,531; US-Patent-Appl-SN-372438) Avail: US Patent Office CSCL 20H

A molecular trap is described which was designed to prevent molecules emitted from a test object in a vacuum chamber from returning and impinging upon the test object. The apparatus simulates outer space environments for evaluating spacecraft and components. Six hollow truncated pyramids are joined at their narrow ends and projected into the x, y, and z planes to form an omnidirectional anisotropic molecular trap, which outlines an area with the sharp edges of the junctions. Molecules vaporized by the test object, having mostly open space and only a few sharp edges before them, move away from the test area and escape via the hollow pyramids. The slanted walls result in a greater probability for molecules to rebound away from then back toward the test object, and they are ultimately removed from the area by the vacuum pump. N.E.N.

N71-17797*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.
PLANETARY ATMOSPHERIC EXPERIMENTAL TEST MASS SPECTROMETER SYSTEM Final Report
Jan. 1971 44 p refs
(Contract NAS5-11165)
(NASA-CR-116544) Avail: NTIS CSCL 03B

The design, fabrication and testing of three six inch rod quadrupole mass spectrometers is documented. Two of the spectrometers were assembled with dual filament ion sources while the third has an open ion source. A third dual filament ion source was also shipped as part of the contract. Author

N71-17812*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
STUDIES FOR SPACE EXPERIMENT DEVELOPMENT Final Report
J. H. Pope Nov. 1970 8 p
(NASA Order W-12752)
(NASA-CR-116409) Avail: NTIS CSCL 22A

Scientific feasibility studies of various space experiment ideas proposed by the scientific community are presented. Two types of activities were undertaken. One of these was to provide expert advice and studies regarding certain aspects of NASA programs. The second was to encourage the conceptual development of certain space experiments. In the second type of activity, a number of potential experiments were considered. Four of these proposed experiments were selected for support. The selection criteria included the following: 1) that the proposed experiments be related to an Environmental Research Laboratory (ERL) mission; 2) that a competent member of the ERL staff is available to carry through the experiment; 3) that the experiment require further conceptual development before feasibility judgments could be made; and 4) that a small amount of financial support could help to make a significant contribution. Author

N71-17868*# Argonne National Lab., Ill. Chemistry Div.
LUNAR SAMPLE ANALYSIS PROGRAM. HIGH SENSITIVITY ISOTOPIC ANALYSIS: APOLLO 11 AND 12. ISOTOPIC ABUNDANCES OF ACTINIDE ELEMENTS IN APOLLO 12 SAMPLES Final Technical Report
P. R. Fields, H. Diamond, D. N. Metta, C. M. Stevens, and D. J. Rokop 31 Jan. 1971 16 p refs Sponsored in part by AEC
(NASA Order T-76536)
(NASA-CR-114870) Avail: NTIS CSCL 03B

The abundances of uranium and thorium were measured mass spectrometrically as 1.70 + or − 0.05 ppm and 6.52 + or − 0.2 ppm, respectively, in the soil and 2.32 + or − 0.07 ppm and 9.06 + or − 0.3 ppm, respectively, in a breccia from Apollo 12. The ratio U-235:U238 was 0.007248 + or − 0.000018 in the soil and 0.00739 + or − 0.0002 in the breccia in agreement with terrestial uranium. The following upper limits were set on the soil: Pu-239 < or = 10 to the minus 9th power ppm and Pu-244 < or = 6 × 10 to the minus 11th power ppm. No unusual alpha particles or spontaneous fissions were observed. The U-236:U-238 ratio in the soil and breccia were 2 × 10 to the minus 7th power and 4.4 × 10 to the minus 8th power, respectively. Author

N71-17913# Space Disturbances Lab., Boulder, Colo.
SOURCES, LOSSES, AND TRANSPORT OF MAGNETOSPHERICALLY TRAPPED PARTICLES
Donald J. Williams Aug. 1970 108 p refs
(ESSA-TR-ERL-180-SDL-16) Avail: SOD $1.00

Trapping, pseudo-trapping, and nontrapping regions within an observed magnetospheric configuration are described. Time averaged proton and electron distributions and available data concerning the alpha particle distribution within the trapping and pseudo-trapping regions are presented. A review of the observational evidence leading to the identification of major sources, losses, and transport of magnetospherically trapped particles is given. Conclusions are summarized and additional suggestions offered in these areas for inner and outer zone protons and electrons. Author

N71-17914# Institute for Telecommunication Sciences, Boulder, Colo.
ON THE ROLE OF VERTICAL NEUTRAL GAS-MOTIONS IN PRODUCING ION CONVERGENCE AT E-REGION HEIGHTS
William H. Hooke Jul. 1970 31 p refs
(ESSA-TR-ERL-175-ITS-112) Avail: SOD $0.30

Theoretical and observational results are used to suggest that vertical neutral-gas motions are generally important in applications

of the magnetoshear theory of sporadic E. It is argued that much of the vertical neutral-gas motion present at these heights must be of gravity-wave origin and shown that gravity-wave-associated vertical motions of the neutral gas should support (oppose) the action of wave-associated horizontal motions in producing ion convergence when the wave is propagating toward the east (toward the west). It is also argued that the full vector ion velocity, rather than only its vertical component, must be used in applications of the magnetoshear theory. Author

N71-17915 Stanford Univ., Calif.
RESEARCHES IN OPTIMAL TRANSFER AND RENDEZVOUS
Walter Heine (Ph.D. Thesis) 1969 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-1545

The transfer between two elliptic orbits is discussed. Two cases are to be investigated; time-free transfer and time-fixed transfer. The transfer, in both cases, is to be accomplished with minimum fuel requirements. Impulsive thrusts are assumed, which have been shown to give optimal solutions in all cases of time-free transfer and in most cases of time-fixed transfer. The Pontryagin maximum principle is applied to the three parameter family of time-free transfers between neighboring non-coplanar, almost circular orbits whose line of nodes lies along their common latus rectum. That is: the transfer requires a small rotation i of the major axis about the latus rectum together with a small change Delta a in semi-major axis and a change Delta e in the small eccentricity. Dissert. Abstr.

N71-17916*# American Science and Engineering, Inc., Cambridge, Mass.
A PROGRAM OF X-RAY ASTRONOMY USING FOCUSING OPTICS Final Report, 7 May 1969 – 5 Feb. 1971
5 Feb. 1971 67 p refs
(Contract NASw-1889)
(NASA-CR-116422; ASE-2612) Avail: NTIS CSCL 03A

The design and characteristics of an optical system to be used with an X-ray telescope are described. The major components of the system are: (1) the mirror assembly, an array of reflecting plates that focus along a line and (2) a thin window position sensitive proportional counter in the focal plane providing eight elements of angular resolution. In addition there is an aspect camera that photographs the star field through a central aperture in the mirror assembly. Author

N71-17920# Princeton Univ., N.J. Dept. of Physics.
[GRAVITATION THEORY] Final Report, 30 Jun. 1968 – 30 Jun. 1970
Robert H. Dicke Nov. 1970 7 p refs
(Contract N00014-67-A-0151-0018)
(AD-714862) Avail: NTIS CSCL 20/10

Being the weakest of all known interactions, gravitation requires astronomical sized bodies for its study. Information concerning the nature of gravitation is obtained by studying the history of the universe, in particular, its age, rate of expansion, average mass density, composition and fragmentation. Also studied is the primeval black-body radiation, in particular its spectral distribution and isotropy. Gravitational effects are very intense in pulsars under study. The solar oblateness and quadrupole moment is related to a fundamental gravitational test. While much was learned in all these fields, a compelling test between the scalar-tensor theory and general relativity has not yet been found. Author (GRA)

N71-17921# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OBSERVATION OF AUTOIONIZING STATES IN THE SOLAR CORONA, JUNE – AUGUST 1970
Arthur B. C. Walker, Jr. and Hugo R. Rugge 20 Nov. 1970 33 p refs
(Contract F04701-70-C-0059)
(AD-715257; TR-0059(9260-02)-2; SAMSO-TR-70-391) Avail: NTIS CSCL 3/2

The authors have observed weak satellites to the lines of the principal series of the helium and hydrogen like ions of magnesium, aluminum, silicon and sulphur in the solar spectrum. These lines coincide in wavelength with the extrapolated positions of transitions from the autoionizing levels in helium like ions, and the autoionizing levels in lithium like ions. The observations provide direct evidence of dielectric recombination in the corona. Author (GRA)

N71-17922# Naval Observatory, Washington, D.C.
ASTRONOMICAL PHENOMENA FOR THE YEAR 1973
1970 77 p refs
(AD-715224) Avail: NTIS; SOD $0.60 CSCL 3/1

Contents: Universal, standard, and daylight times; Religious calendars; Civil calendar; Chronological eras and cycles; Calendar: Julian date, day of week, day of year; Planetary configurations, beginnings of the seasons; Phases of the moon; Morning and evening stars; Equation of time; Polaris: hour angle, declination, transit; Polaris: for finding the latitude by an observed altitude; Polaris: azimuth at all hour angles; Polaris: azimuth at elongation; Table: conversion of arc to time; Table: conversion of hours, minutes, and seconds to decimals of a day; Eclipses of sun and moon; Transit of Mercury; Explanation for rising and setting tables; Sunrise, sunset, and twilight; Moonrise and moonset, northern latitudes. GRA

N71-17984*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SEARCH FOR CARBON AND ITS COMPOUNDS IN LUNAR SAMPLES FROM MARE TRANQUILLITATIS
Keith A. Kvenvolden and Cyril Ponnamperuma, eds. Washington 1970 127 p refs
(NASA-SP-257) Avail: NTIS CSCL 03B

A comprehensive organic analysis of lunar materials from Mare Tranquillitatis is presented. Knowledge of the chemical state of carbon in lunar materials is important in understanding the cosmological history of carbon and in providing new data points for studies of chemical evolution and the origin of life. Apollo 11 provided, for the first time, samples that are not a part of our terrestrial system and have not been exposed for extended periods of time to the earth's biosphere. The analytical scheme that guided the analysis, was designed to obtain maximum information from samples that contain minimal concentration of carbon or carbon-containing compounds. Preliminary examinations of lunar samples suggested that the concentration of carbon to be expected in these samples would be very low, in the order of about 10 micro grams per gram or less. The analysis method follows generally accepted organic geochemical practices but its application to a single sample is unique. A portion of the fine-grained material was divided into seven parts, the weights of which were determined by the nature of the experiment. After a complete pass through the analytical scheme, the analyses providing the greatest information were repeated on additional aliquots of the sample. Author

N71-17985*# Scientific Translation Service, Santa Barbara, Calif.
STUDY OF THE DYNAMIC OF THE VENUS ATMOSPHERE USING THE AUTOMATIC INTERPLANETERY STATIONS VENERA-5 AND VENERA-6 [ISSLED OVANIYEDINAMIKI ATMOSFERY VENERY S POMOSCHYU AVTOMATICHESKIKH MEZHPLANETNYKH STANTSIY VENERA-5 I VENERA-6]
V. V. Kerzhanovich et al. [1970] 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 194, no. 2, 1970

p 288–290 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-116502) Avail: NTIS CSCL 03B

During the motion of the landing capsule (LC) of the automatic interplanetary stations VENER-5 and VENER-6, measurements were made of variations in the radial velocity of the LC in the atmosphere of Venus. These measurements were used to determine the wind velocity pulsations. The same methods used during the landing of VENER-4 [1] were used to measure the velocity and to analyze the results. During the landing by parachute, the velocity of the LC with respect to VENER-5 was determined by the wind velocity, atmospheric density, and aerodynamic characteristics of the LC and the parachute. Author

N71-18003*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE PROGRAM BENEFITS
Frederick A. Zito (M.S. Thesis – N.Y. Univ.) Jan. 1971 106 p refs
(NASA-TM-X-58055) Avail: NTIS CSCL 22A

A series of reports and statements are presented concerning the benefits which have been obtained from space programs. Subjects discussed are: (1) returns to the United States from the space program, (2) technological benefits, (3) management benefits, (4) medical benefits, (5) meteorological benefits, (6) geological benefits, and (7) economic benefits. Author

N71-18007*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LAVA TUBES AND CHANNELS IN THE LUNAR MARIUS HILLS
Ronald Greeley [1970] 49 p refs
(NASA-TM-X-62013) Avail: NTIS CSCL 03B

The Marius Hills region, a volcanic plateau in Oceanus Procellarum, contains numerous rilles, rille-like structures, and chains of elongate craters. Most of these structures characteristically: 1) originate on or near irregular shaped craters associated with features previously interpreted as volcanic domes, 2) trend downslope onto Plateau Plains, 3) generally taper in width and become shallower, 4) are often discontinuous, 5) occupy the center, or apparent crest of a broad ridge, 6) may contain cut-off branches and distributary structures, and 7) may have local reversals in longitudinal slope. Structures having these characteristics are interpreted to be lava channels or partly collapsed lava tubes. Terrestrial lava tubes form exclusively, and commonly, in fluid basalt flows. Recent evidence indicates that viscosities of lunar mare basalt lava flows were conducive for lava tube formation. Terrestrial analogs are offered for structures described in the Marius Hills. The analogs are comparable in qualitative and quantitative geomorphic aspects, excluding that of width. Scaling consideration of lunar reduced gravity accounts for increased width of the lunar structures. Linear and curvilinear rilles trending along equal elevations are interpreted to result from fracturing or faulting. Author

N71-18008*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MARINER 6 AND 7 FLIGHT PATHS AND THEIR DETERMINATION FROM TRACKING DATA
H. J. Gordon, D. W. Curkendall, S. J. Reinbold, D. A. O'Handley, J. W. Zielenback et al 1 Dec. 1970 357 p refs
(Contract NAS7-100)
(NASA-CR-116487; JPL-TM-33-469) Avail: NTIS HC $6.00/MF $0.95 CSCL 22C

Current best estimates of the Mariner 6 and Mariner 7 space probe flight paths are presented. The flight paths are divided into three phases: (1) launch to maneuver or pre-maneuver phase, (2) cruise of post-maneuver phase, and (3) encounter phase. A chronology of events and numerical analyses of the trajectories are presented. Author

N71-18014 Yale Univ., New Haven, Conn.
PRECISE DECLINATIONS AND OPTICAL IDENTIFICATION OF SELECTED RADIO SOURCES
Gerard Franklin Moseley (Ph.D. Thesis) 1969 261 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 70-2772

Methods of measuring accurate declinations with a band-width synthesis interferometer are developed. Observations were made of small angular size extragalactic radio sources, evenly scattered from +54 deg to −28 deg in declination, both for the purpose of instrument calibration and for the preparation of a catalogue of precise declinations to assist in optical identification. The accuracy of the new catalogue was verified by comparison with other precise optical and radio positions, as well as with very precise lunar occultation positions and several supersynthesis brightness distributions of extended sources. The resultant declinations had a mean accuracy of two arc-seconds over 75% of the declination range, with four arc-second accuracy at the greatest zenith distances, more than doubling previous precision in half the cases. Dissert. Abstr.

N71-18015*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REAL-GAS EFFECTS ON THE DRAG AND TRAJECTORIES OF A NONLIFTING 140 DEG CONICAL AEROSHELL DURING MARS ENTRY
Dennis O. Allison and Percy J. Bobbitt Washington Feb. 1971 28 p refs
(NASA-TN-D-6240; L-7522) Avail: NTIS CSCL 22A

The influence of real-gas effects on the drag and trajectories of a 140 deg conical aeroshell during entry into five model Mars atmospheres is discussed. Drag coefficients are obtained by using an approximate technique which enables their determination at every point along a trajectory with reasonable computer time. The standard point mass trajectory equations are used and a spectrum of entry conditions are considered that consist of velocities of 4.27, 4.57 and 4.88 km/sec (14 000, 15 000, and 16 000 ft/sec) and entry-flight-path angles of 13.5 deg, 15 deg, and 17.5 deg. All calculations were made for an entry spacecraft with a ratio of mass to maximum cross-sectional area of 76.5 kg/square meter (0.487 slug/square foot). It is shown that a single curve may be chosen to represent the drag coefficient variations within 2 percent accuracy for all five model atmospheres and all the entry conditions considered. Author

N71-18020*# Arizona Univ., Tucson. Field Emission and Space Systems Lab.
DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Semiannual Report, 1 Jul. – 31 Dec. 1970
Stuart A. Hoenig 31 Dec. 1970 81 p refs
(Grant NGL-03-002-019)
(NASA-CR-116488; SAR-15) Avail: NTIS CSCL 03B

The development and characteristics of remote sensors to detect the composition of planetary atmospheres are discussed. Sensors to detect the presence of oxygen, carbon monoxide, and hydrogen are described. An experimental system to investigate positive ion emission from palladium and the effects of ambient gases is also presented. Author

N71-18021*# National Aeronautics and Space Administration. Washington, D.C.
US-SOVIET AGREEMENT
9 Dec. 1970 6 p
(NASA-News-Release-70-210) Avail: NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, Md. 20740 CSCL 22C

An agreement between the U.S. and the U.S.S.R. for providing compatibility of rendezvous and docking systems of manned

spacecraft and space stations is presented. The spacecraft systems and components which should be considered for compatible design are described. After agreement on the technical requirements each side will independently work out preliminary systems designs. After development of the designs, representatives of both sides will consider them and determine what further work is necessary to assure compatibility. Author

N71-18053*# Translation Consultants, Ltd., Arlington, Va.
LEADERSHIP, COOPERATION AND IDENTITY. CAN WE LEARN ANYTHING FROM THE USA'S 'MOON PROJECT'? [LEDELSE, SAMARBEID OG IDENTITET. KAN VI LAERE NOE AV USA'S MANEPROSJEKT?]
C. W. Sem-Jacobsen Washington NASA Feb. 1970 24 p Transl. into ENGLISH of a Norwegian speech Presented at Oslo Mil. Soc. Meeting on NASA's organ. and goals achieved up to date, 9 Feb. 1970
(Contract NASw-2038)
(NASA-TT-F13447) Avail: NTIS CSCL 05A

The organizational structure of NASA is reviewed in light of the success it has achieved with the U.S. space program. Emphasis of the discussion is placed on the possible application of such organizational aspects as leadership, cooperation, and identity, which are deemed to have played an important part in the accomplishments of NASA, to the creation of a similarly structured organization for overcoming problems within the social, health, and educational sectors. D.L.G.

N71-18057 Yale Univ., New Haven, Conn.
A STUDY OF THE RATE OF ROTATION OF THE EARTH FROM OCCULTATIONS OF STARS BY THE MOON, 1627–1860
Charles Franklin Martin (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 70-2768

Brown's lunar theory, in addition to all known corrections, is applied directly, eliminating the necessity for using the differential-correction process to obtain the theoretical positions for the moon. Improved positions for the occulted stars are used. Also, data pertaining to corrections for the moon's limb accounting for surface irregularities were used. The improved data were combined with numerical and computational techniques to give more precise results. The major part of the study involved obtaining improved values of the difference, Ephemeris Time minus Universal Time, for the period 1627 to 1860. The data were also used for evaluating corrections to the selected orbital elements of the moon and the reference system of the occulted stars. Dissert. Abstr.

N71-18077 Rensselaer Polytechnic Inst., Troy, N.Y.
LIGHT SCATTERING IN REFLECTION NEBULAE
Martha Safford Hanner (Ph.D. Thesis) 1969 174 p
Avail: Univ. Microfilms: Hc $8.00/Microfilm $3.00 Order No. 70-2664

Theoretical U-B and B-V colors and the B and V polarization of reflection nebulae were calculated for plane parallel slab models with various compositions and geometries. The characteristics colors and polarization computed by Mie theory for different kinds of possible interstellar grains can be readily distinguished. In general, there is also a distinct difference between models with the star in front and models having the star behind or embedded deeply in the nebular. The nebular color at 0 deg offset is shown to be model dependent depths in the nebula suffers different amounts of extinction. Consequently, the color at 0 deg cannot be predicted unless the specific geometry is known, as well as the particle composition. Dissert. Abstr.

N71-18092 Connecticut Univ., Storrs.
REGULARIZATION APPLIED TO THE CALCULATION OF OPTIMAL TRAJECTORIES
Andrew John Czuchry (Ph.D. Thesis) 1969 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-1249

Methods of computing optimal rocket trajectories in the presence of two attracting bodies were investigated. Classical methods for numerically integrating the resulting differential equations become cumbersome and inaccurate for rocket trajectories which closely approach the primary attracting bodies and would fail completely if an actual collision could occur. The gravitational attraction of the primary attracting body becomes large without bound whenever the rocket collides with the attracting center. Hence, the differential equations which describe the rocket's motion and the equations which give the necessary conditions for an optimal trajectory exhibit singularities at collision which cause significant computational problems when the rocket closely approaches the attracting celestial body. To alleviate these computational difficulties, a regularizing transformation of the independent variable, time, is introduced to effectively remove the singularities which appear in the original differential equations. The advantages and disadvantages of employing regularizing techniques in optimal trajectory problems are examined. Dissert. Abstr.

N71-18119*# Stanford Univ., Calif. Dept. of Geophysics.
EXAMINATION OF LUNAR SCIENTIFIC OBJECTIVES AND EVALUATION AND DEVELOPMENT STUDIES FOR POSSIBLE POST-APOLLO PERIOD Semiannual Status Report, 1 Jul. –31 Dec. 1970
John R. Booker and Robert L. Kovach 8 Feb. 1971 62 p refs
(Grant NGL-05-020-232)
(NASA-CR-116418) Avail: NTIS CSCL 22A

Seismic velocity models for the moon and the computations of theoretical seismograms to study the lunar seismic reverberation are reported. The possible presence of a low-velocity unconsolidated surface debris layer has implications for the interpretation of lunar active seismic experiments. Some aspects of the thermal history of the moon considered are: internal stress condition and seismicity; the chemical differentiation history; the electrical and magnetic properties of the interior; the sources of surface lavas and tectonic features and the gravitational field. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N71-17056# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Staustrahl- und Kombinationsantriebe.
ON THE INFLUENCE OF AERODYNAMIC DRAG ON RAMJET DRIVEN HORIZONTAL FLYING MISSILES DURING THE BOOSTER PHASE [UEBER DEN EINFLUSS DES LUFTWIDERSTANDES VON STAUSTRAHLGETRIEBENEN HORIZONTALFLUGKOERPERN WAEHREND DER BOOSTERPHASE]
Egbert Riester Aug. 1970 18 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-45) Avail: NTIS; ZLDI Munich: 7 DM

The influence of drag upon the final velocity and distance

travelled by a missile accelerating booster was studied. The equations are discussed and two special cases are numerically calculated. Author (ESRO)

N71-17057# British Aircraft Corp. (Operating) Ltd., Bristol (England).
COMPARATIVE RELIABILITY OF MONO- AND BI-PROPELLANT REACTION CONTROL SYSTEMS FOR A SPIN-STABILISED SATELLITE Final Report
W. Berry, R. Bushell, B. Herdan, and J. S. Williams Paris ESRO Jul. 1970 198 p refs
(Contract ESTEC-899/69)
(ESRO-CR-20) Avail: NTIS

The reliabilities of monopropellant (hydrazine) and bipropellant (nitrogen tetroxide/Aerozine 50) reaction control systems for the position and orientation controls of spin stabilized communication satellites were compared. A realistic mission was studied to determine the operational maneuvers and propellant budgets and a series of design models for each system with various degrees of redundancy was then produced. Outline specifications were produced, the system masses and costs evaluated, and a failure mode and effect analysis carried out. The growth of mass and cost with reliability for each system is discussed and it is shown that for this particular satellite and mission, the monopropellant system has significantly higher reliability at lower cost. Author (ESRO)

N71-17086# Lockheed Missiles and Space Co., Palo Alto, Calif.
COMMAND MODULE OF THE SOIUZ
[1970] 5 p Transl. into ENGLISH from Aviats. Kosmonavt. (Moscow), no. 10, 1970 p 34–36
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The Soiuz spacecraft control panel is described and discussed in relation to the instruments and apparatus used by cosmonauts in flight. Considered are equipment and devices for spacecraft control, communications, power supply, and life support systems. G.G.

N71-17094# Lockheed Missiles and Space Co., Palo Alto, Calif.
LIFT-OFF OF A SPACE BOOSTER
A. Nechaev [1970] 5 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 7, 1970 p 36–38
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Operational commands during lift-off of a space booster are described and explained. Servicing sequences range from tank and pipeline purging to ignition and final release of the rocket from its pad. G.G.

N71-17104# Lockheed Missiles and Space Co., Palo Alto, Calif.
SOVIET ARTIFICIAL EARTH SATELLITES, SPACE PROBES, AND SPACE CRAFT
[1970] 33 p Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 45, 1965 p 42–65
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A survey of U.S.S.R. artificial earth satellite, space probe, and spacecraft launches is presented. Each vehicle is described and its equipment and function are briefly outlined. Launches cover the period October, 1957 through July, 1964. G.G.

N71-17156# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, SEPTEMBER 1970
R. D. Eberst 11 Nov. 1970 22 p
(ROE-STS-108) Avail: NTIS

Stopwatch observations made at stations connected with the section are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N71-17157# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, AUGUST 1970
R. D. Eberst 22 Sep. 1970 28 p
(ROE-STS-105) Avail: NTIS

Stopwatch observations made at stations connected with the section are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N71-17158# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Trauen (West Germany). Abteilung Treibstoffchemie und Treibstofftechnik.
ATTITUDE CONTROL SYSTEMS FOR SATELLITES [UEBER LAGEREGELUNGSSYSTEME FUER SATELLITEN]
Dieter Genthe Mar. 1970 36 p refs In GERMAN; ENGLISH summary
(DLR-Mitt-70-14) Avail: NTIS; ZLDI Munich: 10.50 DM

Thrustor systems for satellites and probes are described in which physico-chemical processes are thrust generating and of interest for reaction control purposes. The functions and applications of catalytic, cold gas, hot gas, subliming, vaporizing, and electrolysis propulsion systems and the contact ion engine are discussed. Author (ESRO)

N71-17211# Academy of Science, Paris (France).
SPACE SHUTTLE THEME: REMARKS
Maurice Roy 1970 4 p Presented at the EUROSPACE US-European Conf., Venice, 22–25 Sep. 1970
Avail: NTIS

Brief comments on the space shuttle and possible US-European cooperation are given and it is concluded that such cooperation may be illusory and deceptive. ESRO

N71-17256# Martin Marietta Corp., Denver, Colo.
SPACE STATION CHARACTERISTICS AND CAPABILITIES
C. B. Hurtt and R. B. Demoret Sep. 1970 41 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22–25 Sep. 1970
Avail: NTIS

The space station mission, its impact on the design requirements, and a guideline experiment program are discussed. The relationships between the experimental program and the support available from the space station are reviewed. The experiment module concepts are discussed in detail and the experiment module sizes and weights are summarized. ESRO

N71-17257# Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris. Space Dept.
THE POSSIBILITIES FOR EUROPEAN AVIONICS IN THE POST APOLLO PROGRAMME
J. Chaumeron and J. P. Guinard 1970 8 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22–25 Sep. 1970
Avail: NTIS

As the European aerospace industry may participate in the Post Apollo program possible avionic contributions, such as the shuttle, space tug, space station, and module fields, are examined. It is concluded that European avionics will be able to make a useful technical and industrial contribution to these programs. ESRO

N71-17258# Sud-Aviation, Paris (France).
CONTROL AND STABILIZATION OF SPACECRAFT. VOL. 2: PASSIVE ATTITUDE CONTROL SYSTEMS [CONTROLE ET STABILISATION DES VEHICULES SPATIAUX. VOL. 2: SYSTEMES PASSIFS DE CONTROLE D'ATTITUDE]
L. Absdie ESRO Jan. 1968 187 p refs In FRENCH; ENGLISH summary Proc. of the 4th ESRO Summer School, Helsingoer, Den., Aug. – Sep. 1966
(ESRO-SP-17-Vol-2) Avail: NTIS

Various types of passive attitude control systems are listed, and the mathematical model of the dynamics of an orbiting satellite is established. The effects of inertial forces, gravitation, radiation pressure, magnetic effects, and, finally, deformation forces, either elastic or arising from a deliberate change of configuration, are treated separately, with a detailed discussion of the configuration of the system and the way it reacts and adapts to orbital conditions.
Author (ESRO)

N71-17333# Technische Univ., Berlin (West Germany). Inst. fuer Raumfahrttechnik.
PROJECT NEPTUNE: DESIGN CRITERIA FOR LARGE REUSABLE SPACE BOOSTERS. Final Report [PROJEKT NEPTUN: ENTWURFSKRITERIEN FUER GROSSE WIEDERVERWENDBARE TRAEGERSYSTEME. Abschlussbericht]
Eckart Elsner Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1970 131 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss. Previously announced as BMWF-FB-W-68-07; see N68-24092 13-30
(BMBW-FB-W-70-38; BMWF-FB-W-68-07) Avail: NTIS; ZLDI Munich: 26.10 DM

Criteria are developed for an unconventional, large, reusable ballistic space transportation system. The concept of "controlled simplicity" as well as market analysis and a system cost model are used to derive suitable system characteristics. A two stage rocket called Neptune is designed conceptually and used as a point of reference. This rocket promises to transport 400,000 kg payloads into orbit for less than $80/kg in the 1980s. This is approximately 1/20 of the corresponding value expected for the Saturn 5 rocket during the 1970s. The report contains design details on structure, propulsion, flight performance, aerothermodynamics, and costs.
Author (ESRO)

N71-17560*# Martin Marietta Corp., Denver, Colo.
ARCHITECTURAL/ENVIRONMENTAL HANDBOOK FOR EXTRATERRESTRIAL DESIGN
Arthur A. Rosener, John R. Baratono, Bill F. Fowler, Edward W. Karnes, and Melvin L. Stephenson Nov. 1970 302 p refs
(Contract NAS9-10761)
(NASA-CR-114846; MCR-70-446; MSC-01530) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The environmental and space utilization criteria for extraterrestrial design of spacecraft are defined and the effects of related environmental elements in providing an optimum habitat for man in space are discussed. Standards were developed for the specific environmental elements of lighting, acoustics, temperature, color, and volume. The related environmental elements texture and design, hygiene and mess provisions, dual room usage, gravity, and interrelated environments were analyzed for their effects on habitabilities of extraterrestrial habitats and vehicles.
Author

N71-17597# Lockheed Missiles and Space Co., Palo Alto, Calif.
THE SATELLITES (SPUTNIKI). COSMOS SERIES 9: PHYSICS ASTRONOMY
Iu. I. Zaitsev 1970 55 p refs Transl. into ENGLISH from Russian book
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The development, launching, and flight characteristics of satellites in the Cosmos series program are reviewed. Atmospheric, ionospheric, and space science observations resulting from this program are discussed.
E.C.

N71-17658*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
CONTROL OF A SPINNING DRAG-FREE SATELLITE TO REDUCE TRAJECTORY ERRORS DUE TO MASS ATTRACTION
Philip Jhin Aug. 1970 87 p refs
(Grant NGL-05-020-007)
(NASA-CR-116516; SUDAAR-408) Avail: NTIS CSCL 22C

An integral controller designed to reduce in-track trajectory error caused by mass attraction was analyzed. Root locus obtained by the frequency symmetry method was used along with analog and digital simulations. Linear and on-off controls with square and octagonal deadspace were compared. The external disturbance forces on the satellite were studied with respect to the mass attraction force that results. An error analysis of the integral controller mechanization shows that the in-track trajectory error caused by mass attraction is reduced from 150 km to 72 m (after 1 year) using integral control. An analysis is made of the trapping susceptibility of a system versus the control gain.
Author

N71-17629* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THRUST AND DIRECTION CONTROL APPARATUS Patent
Robert W. Cubbison and James F. Connors, inventors (to NASA) Issued 4 Oct. 1966 (Filed 30 Sep. 1964) 4 p Cl. 244-3.22
(NASA-Case-XLE-03583; US-Patent-3,276,376; US-Patent-Appl-SN-400617) Avail: US Patent Office CSCL 22B

The thrust and attitude control apparatus is applicable to aircraft, rockets, missiles, satellites, and space vehicles. A jet nozzle in a movable canard surface or fin configuration is mounted on the uppermost stage of the vehicle. At launch and in the low Q and space portion of a flight, a pulse or reaction jet leading to the exhaust nozzle provides control since the dynamic pressure is too low to generate the required forces. In the sensible atmosphere, pitch, yaw, and roll control moments are generated by deflecting equal or differential amounts of the canard surfaces. This produces forces in a manner similar to that of a conventional aerodynamic control surface.
E.C.

N71-17678 Stanford Univ., Calif.
MINIMUM FUEL ATTITUDE CONTROL OF A NONLINEAR SATELLITE SYSTEM WITH BOUNDED CONTROL BY A METHOD BASED ON LINEAR PROGRAMMING
Gary Daniel Wolske (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-1630

The computation of fuel optimal controls for the large angle attitude motions of a satellite system in which the control is obtained by three sets of gas jets with bounded thrusts, each generating torques about one of the principal axes of inertia, is presented. Using a result from optimal control theory, an algorithm is developed that iteratively improves on an initial guess (nominal) for the control history which does not meet terminal constraints and/or does not minimize the fuel cost. In using the algorithm, which is based on linear programming, it is necessary to express the variation of the fuel cost and variations of the components of the terminal state constraint vector as linear functions of variations in the control. The algorithm is tested on two sets of satellite differential equations. In one case, all dynamical effects are

considered. In the other case, because control torque bounds are large enough, it is possible to neglect gravity gradient torque effects and orbital motion effects. Dissert. Abstr.

N71-17679* Lockheed Aircraft Corp., Burbank, Calif.
AERODYNAMIC PROTECTION FOR SPACE FLIGHT VEHICLES Patent
Richard T. Parmley, inventor (to NASA) Issued 21 Mar. 1967 (Filed 27 Jul. 1965) 7 p Cl. 244-1 Sponsored by NASA
(NASA-Case-XNP-02507; US-Patent-3,310,256;
US-Patent-Appl-SN-475299) Avail: US Patent Office CSCL 22B

A protective coating for space vehicles to provide thermal insulation and meteoroid protection is discussed. The protection is accomplished by attaching flexible, inflatable bags around the outer surface of the space vehicle. The air space within the inflatable bags provides thermal insulation and wire mesh on the exterior of the bags provides meteoroid protection. NASA

N71-17680* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SELF SUPPORTING SPACE VEHICLE Patent
William John O'Sullivan, Jr., inventor (to NASA) Issued 15 Aug. 1961 (Filed 20 Aug. 1959) 4 p Cl. 220-1
(NASA-Case-XLA-00117; US-Patent-2,996,212;
US-Patent-Appl-SN-835153) Avail: US Patent Office CSCL 22B

The design of a flexible, lightweight space balloon or satellite capable of being inflated into a desired configuration and retaining the configuration independently of the inflating medium is described. The pneumatic erection of the space vehicle by a gas cylinder is performed until the folded metal film covering develops a permanent set. The inherent stiffness of the metal skin material results in a space vehicle adapted to support itself in a particular configuration in the absence of internal pressure. NASA

N71-17690 Stanford Univ., Calif.
THE CONTROL AND USE OF LIBRATION-POINT SATELLITES
Robert Willard Farquhar (Ph.D. Thesis) 1969 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-1524

Satellite station-keeping in the vicinity of the unstable collinear libration points, L1 and L2 is discussed. Station-keeping problems at other libration points, including an isosceles-triangle point, are also treated, but to a lesser degree. A detailed analysis of the translation-control problem for a satellite in vicinity of a collinear point is presented. Simple linear feedback control laws are formulated, and stability conditions are determined for both constant and periodic coefficient systems. It was found that stability could be achieved with a single-axis control that used only range and range-rate measurements. The station-keeping cost with this control is given as a function of the measurement noise. If Earth-based measurements are available, this cost is very low. Dissert. Abstr.

N71-17691* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TECHNIQUE FOR CONTROL OF FREE-FLIGHT ROCKET VEHICLES Patent
Robert J. Keynton, inventor (to NASA) Issued 21 Mar. 1967 (Filed 31 Aug. 1964) 11 p Cl. 244-3.14
(NASA-Case-XLA-00937; US-Patent-3,310,258;
US-Patent-Appl-SN-393461) Avail: US Patent Office CSCL 22B

The development of a method for controlling free flight rocket vehicles is discussed. The method consists of analyzing perturbations in the trajectory of the missile and adjusting the time of firing of the second stage to insure that the third stage ignition will occur at the proper point in the trajectory. NASA

N71-17729* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STABILIZATION OF GRAVITY ORIENTED SATELLITES Patent
Bruce E. Tinling and Vernon K. Merrick, inventors (to NASA) Issued 1 Nov. 1966 (Filed 27 Jul. 1964) 8 p Cl. 244-1
(NASA-Case-XAC-01591; US-Patent-3,282,532;
US-Patent-Appl-SN-385527) Avail: US Patent Office CSCL 22B

A stabilization system for gravity-oriented satellites is described in which a single damper rod damps oscillations about the three orthogonal axes of pitch, roll, and yaw. The satellite is constructed to have a first axis of minimum moment of inertia, a second axis of maximum moment of inertia at right angles to the first axis, and a damper rod pivotally attached to the main body of the satellite. The damper rod is so attached that in its equilibrium position the rod is at an angle to the axis of maximum moment of inertia to the composite structure, which angle is other than 90 degrees. E.C.

N71-17730* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTI-MISSION MODULE Patent
Jay H. Laue, inventor (to NASA) Issued 22 Nov. 1966 (Filed 7 Oct. 1964) 9 p Cl. 102-49
(NASA-Case-XMF-01543; US-Patent-3,286,629;
US-Patent-Appl-SN-402365) Avail: US Patent Office CSCL 22B

A rocket powered space vehicle stage design is described with components fixed in size and relationship, and other changeable components for use in a wide variety of space missions. The fixed hardware for the stage includes the rocket engines, the thrust structure connecting the engines to the stage support rings, the thrust vector control system, the propellant tank bulkheads, the propellant feed systems, the tank support structure, and the pressurization system. The changeable items include the tank cylindrical sections, the outer shell, which is load and length tailored to the mission, and the support rings. E.C.

N71-17769*# AiResearch Mfg. Co., Los Angeles, Calif.
HABITABILITY GUIDELINES AND CRITERIA
C. E. Righter, D. P. Nowlis, V. B. Dunn, N. J. Belton, and E. C. Wortz 7 Jan. 1971 473 p refs Original Contains Color Illustrations
(Contract NAS8-25100)
(NASA-CR-103028; Rept-70-6651) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Designs and criteria for the habitability of a long-duration multiman space station were produced by a comprehensive study beginning with a literature search of applicable multicrew long-term missions; progressing to development of habitability evaluation parameters; and concluding with analytical and design studies of three major types of spacecraft compartments – the sleeping, wardroom, and hygiene compartments. The study was directed toward zero-g conditions for a 12-member crew. Since future long-duration missions probably will be conducted with crews of both sexes, the differing requirements for female crew members in some areas were considered. However, cultural differences were not considered in the study of habitability and the resulting definitions of space modulators. Author

N71-17770*# Fansteel, Inc., Newbury Park, Calif. Reflective Laminates Div.
LOW COST ABLATIVE HEAT SHIELDS FOR SPACE SHUTTLES
R. E. Dulak and A. M. Cecka [1970] 55 p
(Contract NAS1-9947)
(NASA-CR-111814) Avail: NTIS CSCL 22B

Ablative heat shields provide reliable and efficient thermal

protection for entry vehicles. However, the present high cost and single-mission life of the heat shields impose a constraint on their application to reuseable logistic vehicles. Therefore, low cost ablative systems must be developed to make them feasible for the Space Shuttle. Cost reductions can be achieved through the use of materials, tooling and methods that provide for ease of fabrication and require fewer man-hours of labor. Actual fabrication of full-size panels provides a basis for realistic cost estimates of heat shield production. This approach was investigated in a study of two ablation material systems and a honeycomb panel configuration. One material was a phenolic/nylon/Microballoon powder system. The other was a silicone elastomer/Microballoon mixture. The ablation materials were applied to 1/4 and 3/8 inch cell size fiberglass reinforced phenolic honeycomb cores bonded to fiberglass/epoxy resin face sheets. One flat and one curved panel was fabricated from each material combination for a total of eight panels. Production cost estimates were prepared from the cost data and suppliers material prices. Author

N71-17771*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
COMMUNICATIONS SATELLITE HANDBOOK: A BRIEF REFERENCE TO CURRENT PROGRAMS, REVISION 3
Jul. 1970 66 p
(NASA-TM-X-66711) Avail: NTIS CSCL 22B

The configurations and performance of various communications satellites are presented. Satellites discussed are: (1) Intelsat 1 (Early Bird), (2) Intelsat 2, (3) Intelsat 3, (4) Intelsat 4, (5) Applications Technology Satellites, (6) Tracking and Data Relay Satellites, (7) Defense Communication Satellites, and (8) Tactical Satellite Communications Program. Author

N71-17781 Yale Univ., New Haven, Conn.
TIME AND FUEL OPTIMAL CONTROLS IN THE PRESENCE OF MEASUREMENT UNCERTAINTIES
Harold R. Dessau (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 70-2723

A class of stochastic optimal control problems associated with the task of controlling a rocket or space vehicle under circumstances of noisy measurements and strictly bounded control inputs are examined. Performance criteria of minimum time, minimum expected fuel consumption, and least upper bound fuel consumption are considered. Optimal feedback gains are precalculated in terms of the desired performance criterion, a priori known statistical information about the measurements and other random quantities, and the known system dynamics and constraints. The closed loop prestructured optimal control consists of a combination of the precalculated feedback gains and the history of noisy measurements on the system. Dissert. Abstr.

N71-17784 California Univ., Los Angeles.
DYNAMICS, CONTROL REQUIREMENTS AND OPTIMAL PERFORMANCE OF A TWO-BODY SATELLITE AUGMENTED BY CONSTANT SPEED ROTORS IN A GRAVITATIONAL FIELD
Robert Keith Williamson (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-2271

The dynamics, control requirements, and optimal performance of a hinged, two-body satellite attitude control system in circular orbit are examined. The main portion of the satellite, which is a gyrostat, is connected to the auxiliary body by a visco-elastic hinge coupling at the respective center of mass of each body to provide the necessary damping for librations from the equilibrium orientation. This augmented gravity stabilized system was synthesized with the motivation of providing increased pointing accuracies over more conventional gravitationally stabilized vehicles. The linearized equations of rotational motion in matrix form are developed for a general two-body satellite system with one of the bodies containing a symmetric, constant speed rotor. The equation that must be satisfied in order that an equilibrium orientation of the satellite system exist is isomorphic to the equations that must be satisfied by a gyrostat. Dissert. Abstr.

N71-17808*# Environmental Research Associates, Essex, Md.
MAN-MACHINE SHUTTLE SUPPORT PROGRAM
Harry L. Loats, Jr. and G. Samuel Mattingly [1970] 57 p refs
(Contract NAS1-897)
(NASA-CR-111847; ERA-71-1) Avail: NTIS CSCL 22B

A planning study was accomplished to determine human factors support requirements for the space shuttle program. The human factors effort emphasized manned-simulation techniques and specifically addressed cargo and crew transfer, rendezvous and docking, extravehicular activity, and abort. Current shuttle contract information was used as a basis to determine composite vehicle and mission models. Program plans were specified for three main areas: (1) cargo transfer, (2) crew transfer, and (3) rendezvous and docking. The individual plans were divided into three areas: (1) study requirements, (2) mock-up and experiment hardware requirements, and (3) experiment performance sequence. A combined program plan including the three areas was produced covering the 1971 period. Author

N71-17917*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QUALIFICATION AND TESTING OF AN ELECTRICALLY PROPOLLED SPACECRAFT-SERT 2
James F. De Pauw and Louis R. Ignaczak Washington Mar. 1971 32 p refs
(NASA-TM-X-2199; E-5977) Avail: NTIS CSCL 22B

Development of a spacecraft using ion thrusters designed to operate for 6 months entailed unusual qualification problems. Testing with ion thrusters required vacuum operation. The spacecraft was in the same chamber with a plasma created by the thruster. High voltages required for ion thrusters may cause electrical breakdowns or cause the spacecraft and Aerospace Ground Equipment (AGE) to receive high power transients. Also, components that were qualified for a 6-month mission were scarce. The resolution of these problems is described. Since the program scheduled only a single flight, an extensive testing and development program was conducted to launch and successfully operate the spacecraft with one attempt. Author

N71-17918*# TRW Systems Group, Redondo Beach, Calif.
TASK 7 SPACE STORABLE PROPELLANT MODULE ENVIRONMENTAL CONTROL TECHNOLOGY
R. E. De Land, O. O. Haroldsen, and R. N. Porter 15 Jan. 1971 103 p refs
(Contract NAS7-750)
(NASA-CR-116426; TRW-14051-6008-T0-00) Avail: NTIS CSCL 22B

An analysis of candidate thermal control systems for liquid rocket propellant storage is presented. Flight thermal control may be effected by supplying heat to the tank and moderating the tank temperature by either a radiator or louver assembly. Whether a radiator or louver assembly is used is dependent upon the stability of the radioisotope thermal generator. If the variation in the RTG temperature is greater than plus or minus 100 degress R, a louver assembly should be used. Author

N71-17919*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
REFURBISHMENT COST STUDY OF THE THERMAL PROTECTION SYSTEM OF A SPACE SHUTTLE VEHICLE Final Report
D. W. Haas 1 Mar. 1971 335 p refs
(Contract NAS1-10093)
(NASA-CR-111832) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Design and cost details associated with ablative, metallic and nonablative nonmetallic types of thermal protection systems (TPS) and associated attachment techniques were identified, evaluated and characterized. Primary load carrying structural arrangements, suitable TPS attachment techniques, operational labor cost estimates, design and cost uncertainties, and TPS component parts for a full-scale mockup and a detailed experimental test plan are discussed. Author

N71-18019*# National Aeronautics and Space Administration. Washington, D.C.
VANGUARD: A HISTORY
Constance McLaughlin Green and Milton Lomask 1970 325 p refs
(NASA-SP-4202) Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

The origin, course of development, and results of the first American earth satellite project are discussed. The scientific and technical problems in the exploration of outer space are analyzed, and the climate of American opinion both before and after the launchings of the first Soviet satellites is discussed. The contribution of the satellite program to human knowledge is evaluated briefly. R.B.

N71-18060*# Martin Marietta Corp., Denver, Colo.
SPACE SHUTTLE PROPULSION SYSTEMS ON-BOARD CHECKOUT AND MONITORING SYSTEM DEVELOPMENT STUDY Quarterly Progress Report, Oct. – Dec. 1970
Dec. 1970 324 p refs
(Contract NAS8-25619)
(NASA-CR-116427; MCR-70-274) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

An onboard checkout, performance monitoring, emergency detection, and postflight evaluation system for the space shuttle propulsion systems is described. An analysis is made of the space shuttle main, auxiliary, and airbreathing propulsion systems functional performance and durability requirements to define the checkout, monitoring, and evaluation criteria and to evolve an approach for performing the functions of preflight checkout, performance monitoring, fault isolation, diagnosis, emergency detection, display, data storage, and postflight evaluation and maintenance. Author

N71-18088*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
REFURBISHMENT COST STUDY OF THE THERMAL PROTECTION SYSTEM OF A SPACE SHUTTLE VEHICLE Final Report
Robert J. Peterson [1970] 324 p
(Contract NAS1-10094)
(NASA-CR-111830) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

A refurbishment cost study was made to identify the costs associated with inspection, repair, and replacement of components for thermal protection systems (TPS), and to develop efficient techniques for performing these operations. Ablative, metallic, and nonmetallic heat shields are considered. Refurbishment tasks and TPS material subsystems matrices are developed for five TPS system configurations using a delta body orbital vehicle. Operational costs are determined using normal pricing procedures to arrive at a common basis for comparing alternative operational methods and techniques, as well as to indicate the effect of TPS material variations on cost. System level costs are developed from a mission model which specifies a ten-year-life system, composed of eight vehicles flying 75 missions per year. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N71-16965# California Univ., Berkeley. Structural Engineering Lab.
RESPONSE IN A TRANSVERSELY ISOTROPIC ROD TO A TRANSIENT INPUT
H. D. Mc Niven and Y. Mengi Aug. 1970 21 p refs
(Grant NSF GK-10070)
(PB-195087; UCSESM-70-16) Avail: NTIS CSCL 20L

In this study the response in a transversely isotropic, semi-infinite elastic rod is found to be time dependent. The solution follows closely the method developed by Skalak for isotropic rods which uses integral transforms to solve the governing equations. The solution differs from that of Skalak, apart from material properties, in that in this study mixed-mixed conditions are assumed for the end of the rod. The responses are found at a distant station and are expressed in terms of the axial and tangential strains. Author (GRA)

N71-17038# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF POLYGONAL PLATES BY A VARIATIONAL METHOD
L. A. Volobueva et al [1970] 4 p refs Transl. into ENGLISH from Prikl. Mekh. (Ukrainia SSR), v. 6, no. 10, 1970 p 124–128
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A plate of polygonal shape, which is the forward wall of the body of a coal skip with a sectorial lock, is analyzed. Underlying the method of analysis proposed, which will permit solution of problems for domains of more complex shape, is the utilization of V. L. Rvachev functions, which are continuous functions of real arguments with properties analogous to those of the Boolean functions of logic algebra. The construction of equations of complex geometric objects are formalized by using the R-functions, and they are written as a single analytical representation. Author

N71-17039# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON DEFORMATION THEORIES OF PLASTICITY
D. D. Ivlev [1970] 6 p refs Transl. into ENGLISH from the publ. 'Problemy Gidrodinamiki i Mekhaniki Sploshnoi Sredy' Moscow, Nauka, 1969 p 233–239
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Deformation theory of plasticity for smooth and piecewise-smooth loading surfaces are discussed. Conditions for which the relationships of flow theory for smooth and piecewise-smooth flow surfaces result in the relationships of the theory of small elastoplastic deformations are considered. Author

N71-17209# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
AXISYMMETRIC LOCAL LOADING ON SANDWICH PANELS

D. W. Martin, Susan M. Picken, and B. T. Hinde Jul. 1970 51 p refs
(NPL-DNAM-86) Copyright. Avail: NTIS

Solutions to two problems in the elastic response of a clamped sandwich panel, composed of a core between identical faceplates, to a load applied on one face e.g. shoe pressure on aircraft gangways, dropping of sharp-cornered containers on freight-hold floors, are presented. Pure compression load-displacement ratios were computed for a range of sandwich constructions and load distributions. Author (ESRO)

N71-17212# Southampton Univ. (England). Inst. of Sound and Vibration Research.

ON THE REPRESENTATION OF CONTINUOUS RANDOM PRESSURE FIELDS AT A FINITE SET OF POINTS

J. Hammond and C. A. Mercer Jun. 1970 64 p refs
(ISVR-TR-30) Avail: NTIS

A technique for the approximate determination of the response of structures to excitation by random pressure fields in which the distributed pressure field is replaced by a set of (random) lumped forces and moments which are correlated one with another was applied to chain-like structures. A transfer matrix approach was used as this allows lumped forces and moments to be simply incorporated at different points in the structure. A simply supported uniform beam of unit width with three forms of excitation fields, (1) a pressure field that is fully correlated in space (normally incident plane waves), (2) a field completely uncorrelated in space, (3) a convecting random pressure field with no spatial decay, are considered. Author (ESRO)

N71-17330# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

AN INVESTIGATION OF THE SCATTER IN VARIABLE-AMPLITUDE FATIGUE-TEST RESULTS OF 2024 AND 7075 MATERIALS

A. M. Stagg London Aeron. Res. Council 1970 119 p refs Supersedes RAE-TR-69110; ARC-32032
(ARC-CP-1123; RAE-TR-69110; ARC-32032) Copyright. Avail: NTIS; HMSO: £1.50p; BIS: $5.40

The fatigue life scatter of identical specimens was estimated, using a log-normal distribution, from several experimenters' results. These estimates were analyzed for the effect of various test loading parameters on the magnitude of the scatter produced and the results are discussed in terms of a simple fatigue failure model. Author (ESRO)

N71-17334# National Physical Lab., Teddington (England). Aerodynamics Div.

THE USE OF AERODYNAMIC-STABILIZING STRAKES ON CHIMNEY STACKS SUPPORTING PIPES

D. E. Walshe and C. F. Cowdrey Feb. 1970 29 p refs
(NPL-AERO-1310) Copyright. Avail: NTIS

Aerodynamic stability tests were carried out on linear mode models to compare the excitation of a model stack of circular cross section with that for a stack supporting a small diameter pipe. The presence of the pipe increased the excitation and it was reduced, but not eliminated, by strakes. Author (ESRO)

N71-17355*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VIBRATION AND FLUTTER TESTS OF A PRESSURIZED THIN-WALLED TRUNCATED CONICAL SHELL

Robert Miserentino and Sidney C. Dixon Washington Feb. 1971 25 p refs
(NASA-TN-D-6106; L-7345) Avail: NTIS CSCL 20K

The breathing vibration modes of an unstiffened truncated conical shell have been determined and the shell was tested for flutter at a Mach number of 3.0. The shell was made of stainless steel and had a ratio of length to large radius of 3.72, a ratio of large radius to thickness of 811, and a semivertex angle of 0.26 rad (15 deg). Experimental results are presented to show the variations of resonant frequency with internal pressure and with circumferential wave number. For sufficiently large pressures and a small number of circumferential waves, the variation of frequency squared with pressure departed from its originally linear characteristic. The experimental results compared favorably with the calculated results although the theory tended to overestimate the frequency increase which resulted from an increase in internal pressure. The theory did not predict the nonlinear variation of frequency squared with pressure. A flutter point obtained in the wind-tunnel test is compared with a flutter boundary calculated from an analysis based on a Donnell-type theory. The relationship between experiment and theory is similar to the trends previously established for cylindrical shells. Author

N71-17403# Rensselaer Polytechnic Inst., Troy, N.Y. Mechanics Div.

STRESS ANALYSIS FOR ELEVATED TEMPERATURE LOW-CYCLE FATIGUE WITH HOLD-TIME

Erhard Krempl *In* AGARD High Temp. Turbines Jan. 1971 17 p refs (See N71-17372 07-28)
Avail: NTIS HC$6.00/MF$0.95

The behavior of structural materials under simulated service conditions at elevated temperature is shown to be characterized by strain rate (frequency) sensitivity, creep, relaxation and cyclic hardening or softening. These phenomena and prior deformation history have a considerable effect on the subsequent deformation and fracture behavior. A realistic stress analysis for elevated temperature low-cycle fatigue with hold-time has to consider these material properties so that the stresses can be computed throughout the component as a function of time. It is shown that none of the conventionally used descriptions of material behavior (elasticity, plasticity, creep or viscoelasticity) can reproduce all the important observed phenomena. A new approach is proposed which considers time-dependent, nonlinear, and history effects. Author

N71-17521# Sandia Corp., Albuquerque, N.Mex.

FAILURE PROBABILITIES FOR LOG-NORMAL CAPACITY DISTRIBUTION WITH NORMAL DISTRIBUTION OF DEMANDS

Jack W. Reed Oct. 1970 12 p refs
(SC-RR-70-547) Avail: NTIS

Ordinary engineering designs usually overwhelm any wildly varying parameter with a large safety factor. In problems with reasonable errors (percents), a normal error curve is usually adequate for economical designs. In some cases, where great reliability is required, extrapolation out to low-probability tails of a distribution is necessary so the correct distribution function must be used, normal, log-normal, or some other form. In estimating net effects of small failure probabilities on large populations, that is, wind damage to windows, it is necessary to use mixed distributions to estimate damages. Glass plate failures may be shown to approximately follow a log-normal distribution with load. Wind loads in typical turbulent flows, however, follow a normal distribution. This problem was parameterized to allow numerical computer integration for failure probability in terms of three normalized variables, and results graphed for application to similar problems. Author

N71-17522# Oak Ridge National Lab., Tenn. Reactor Div.

ADDENDUM: EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF THE STRUCTURAL BEHAVIOR OF NOZZLE-TO-SHELL ATTACHMENTS

W. L. Greenstreet and R. C. Gwaltney Nov. 1970 46 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2526-Add) Avail: NTIS

Elastic and plastic behavior of single nozzle-to-shell attachments is being studied, as well as elastic behavior of multiple nozzles in closely spaced clusters. Author (NSA)

N71-17523# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).

CYCLIC PLASTIC DEFORMATION AND THE STRAIN CONCENTRATION FACTOR

K. Wellinger (Stuttgart Univ.) et al Fraunhofer Ges. Dec. 1969 33 p refs Trans. into ENGLISH from VDI Ber. (Dusseldorf), no. 129, 1968 Sponsored by Deut. Forsch. Gemeinschaft
(TU-84-1970) Copyright. Avail: NTIS

The maximum transverse strain (T) at the notch root of centrally notched flat specimens was determined with a lateral extensometer. Measurements on cylindrical specimens gave the longitudinal and transverse strain relationship as a function of total strain and it was used to convert the T values into corresponding values of longitudinal strain at the notch root. The strain concentration factor was used to determine the number of cycles to notched specimen crack initiation. Author (ESRO)

N71-17524# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).

STRENGTH OF LIGHT METAL ALLOY RODS WITH IRREGULAR NOTCHES UNDER CYCLIC TENSILE LOADS AND PERIODICALLY INTERSPERSED COMPRESSION LOADS [ZUR FRAGE DES FESTIGKEITSVERHALTENS REGELLOS IM ZUG-SCHWELL-BEREICH BEANSPRUCHTER GEKERBTER LEICHTMETALLSTAEBE BEI PERIODISCH EINGESTREUTEN DRUCKBELASTUNGEN]

E. Haibach, D. Schuetz, and O. Svenson Fraunhofer Ges. Mar. 1970 25 p refs In GERMAN; ENGLISH summary Sponsored by Deut. Forsch. Gemeinschaft
(FB-78-1969) Avail: NTIS

The cyclic plastic strains and stresses occurring at the notch root during a typical flight-by-flight load sequence were used to study the effect of the ground-to-air cycle on the fatigue life. Local stress histories were determined by recording local strain histories during cycling and reproducing these histories in simple unnotched 2024 material specimens. Author (ESRO)

N71-17535# Fraunhofer Institut, Freiburg (West Germany).

THERMALLY INDUCED ELASTIC STRESSES AND THEIR EFFECT ON CRACK FORMATION AND PROPAGATION [THERMISCH INDUZIERTE ELASTISCHE SPANNUNGEN UND IHR EINFLUSS AUF AUSLOESUNG UND AUSBREITUNG VON BRUECHEN]

Johann Georg Blauel Jul. 1970 141 p refs In GERMAN
(Rept-5/70) Avail: NTIS

Dangerous situations arise for bodies with sharp, cracklike grooves when they are subjected to thermal and mechanical loads, so stress conditions and material behavior in such cases were studied. Flat plates of transparent, linearly elastic mirror glass were used for fracture mechanics, stress field (interferometry), and rupture (ultrasonic fractography) analyses. ESRO

N71-17536# Oak Ridge National Lab., Tenn.

MEASUREMENT OF RESIDUAL STRESSES

A. G. Cepolina and D. A. Canonico Oct. 1970 32 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3113) Avail: NTIS

A modification of the Sachs boring-out method for determining residual stresses was developed. This technique permits the determination of the distribution of the stresses and their levels over extremely short increments of distances. It was used for measuring the residual stresses in gas tungsten-arc welds made in Hastelloy N. The specimen was 1/2-in.-thick plate, 12 in. diameter. Circular welds 6 in. in diameter were simultaneously deposited on both flat faces. The equations for the calculation of residual stresses in this specimen geometry are given. The maximum value of tangential residual stress was found to be about 50,000 psi and was not particularly affected by either the shielding gas or heat input. Stress relieving at 1600 F for 4.5 hr proved to be the optimum heat treatment and reduced the tangential residual stress to about 5000 psi. Lowering of the maximum residual stress to about 10,000 psi was achieved at 1400 F after 6 hr; however, lower temperatures even for times as long as 100 hr only reduced the maximum residual stress by about 25%. Author (NSA)

N71-17558*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.

STRESS ANALYSIS FOR A CASSINIAN GEOMETRY SPACE STATION UNDER INTERNAL PRESSURE

J. E. Martinez and James A. Stricklin Dec. 1970 20 p refs
(Grant NGL-44-001-044)
(NASA-CR-114847; Rept-70-016) Avail: NTIS CSCL 22B

The design of a cylindrical shell with a Cassini curve as a bulkhead to withstand a pressurized condition in space without the use of truss reinforcing members is discussed. A design was obtained which does satisfy the requirements. A detailed stress analysis of the selected design is presented. The analysis only considers the internal pressure loading. The shell has a torus section attached to it and displays the properties of a Cassinian curve. The reason for the Cassinian geometry is that supposedly only tensile forces will be developed for an internal pressure loading. Author

N71-17562*# Wyle Labs., Huntsville, Ala. Research Div.

EXPERIMENTAL STUDY OF VIBRO-ACOUSTIC RESPONSE OF STIFFENED CYLINDRICAL SHELLS

V. M. Conticelli and R. W. White Jan. 1971 129 p refs
(Contract NAS9-10423)
(NASA-CR-114852; WR-71-2) Avail: NTIS CSCL 20K

Results of an experimental vibro-acoustic research program in which an aluminum cylindrical shell was subjected to a reverberant acoustic field are presented. Dimensions of the shell are 8 ft. (length) × 4 ft. (diameter) × 0.08 in. (wall thickness). The shell was tested with various stiffener configurations, namely: without stiffeners, with two ring frames, with two ring frames and four stringers, and with two ring frames and eight stringers. All stiffeners were uniformly spaced; all configurations were tested with both ends of the shell closed by thick plywood bulkheads. Measurements made included one-third octave band levels of the external acoustic field, internal acoustic field, axial and circumferential strains of the shell wall, and accelerations of the shell wall and stiffeners. These data are presented in tabulated form and in graphs of normalized acceleration power spectral densities. Theoretical response predictions are made for each configuration tested and for several assumed values of damping; these results are compared with measured response data. The comparison shows reasonably close agreement between theory and test when relatively low structural damping values are used in the computations. Measured transient decay rates obtained from impact tests of the specimen partially validate the low damping values used theoretically. Author

N71-17571# Sandia Corp., Albuquerque, N.Mex.

METHOD FOR COMPUTING THE COLLAPSE LOADS OF HEATED, ARBITRARILY LOADED SPHERICAL SHELLS IN AN ELASTIC MEDIUM

Walter B. Murfin Oct. 1970 52 p refs

(SC-DR-70-218) Avail: NTIS

A computer program which computes the response of a spherical shell to arbitrary loads is described. Preheating is included, and the kinetics of strength loss are accounted for. Arbitrary distributions of impulse, temperature, initial stress, and pressure are allowed, as well as an inertial load of arbitrary time history. However, all loadings must be symmetric about a diameter. Shear deflections and rotary inertia can be included as a user option. Author

N71-17672*# New York Univ., N.Y. Dept. of Mechanical Engineering.

RESIDUAL STRESSES DEVELOPED IN MOLDING A FLAT SHEET OF A CHEMICALLY-HARDENING RELATIVELY INCOMPRESSIBLE MATERIAL

Myron Levitsky and Bernard W. Shaffer Sep. 1970 10 p refs

(Grant NGL-33-016-067)

(NASA-CR-116504; S-70-5) Avail: NTIS CSCL 20K

Residual thermal stresses in a flat sheet molded from a chemically hardening material are approximated by an expression having a simple closed form representation whenever the shear modulus is much smaller than the bulk modulus in the fully hardened material. The result is used to evaluate the hardening rate which yields maximum residual stresses in the interior of a sheet. A comparison between numerical results obtained from the exact and approximate solutions to the problem shows that the more easily obtained latter results represent a conservative estimate of the exact stress distribution. Author

N71-17609* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CABLE ARRANGEMENT FOR RIGID TETHERING Patent

Arthur W. Vogeley and Roy F. Brissenden, inventors (to NASA) Issued 4 Oct. 1966 (Filed 6 Aug. 1964) 5 p Cl. 212-11

(NASA-Case-XLA-02332; US-Patent-3,276,602; US-Patent-Appl-SN-388024) Avail: US Patent Office CSCL 13M

A force separation rigid tethering system using cables is described. The cables are arranged in pairs with at least one pair tethering at intervals of not greater than 45 degrees about the perimeters of the separated bodies. The cables reel up on a large drum to provide closure and separation of the body while requiring little or no drive power for the cable linkage. E.C.

N71-17645* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MEANS AND METHOD OF MEASURING VISCOELASTIC STRAIN Patent

Anthony San Miguel and Robert H. Silver, inventors (to NASA) Issued 20 Sep. 1966 (Filed 8 Jan. 1964) 6 p Cl. 73-88 Sponsored by NASA

(NASA-Case-XNP-01153; US-Patent-3,273,381; US-Patent-Appl-SN-336608) Avail: US Patent Office CSCL 13M

A photographic method is described for measuring viscoelastic properties in solid propellants and other materials. The materials are coated with a photoelastic material, internally pressurized, exposed to polarized light, and the resulting strain patterns are photographed for analysis. E.C.

N71-17782# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.

BIREFRINGENCE IN VISCOELASTIC MATERIALS

R. S. Rivlin and G. F. Smith Oct. 1970 36 p refs

(Contract DAAD05-69-C-0053)

(AD-714998; CAM-110-11; BRL-CR-19) Avail: NTIS CSCL 20/4

The report concerns isotropic materials which undergo deformations and for which the electromagnetic constitutive equations take the form of a linear relation between the electric displacement field and electric field and a linear relation between the magnetic intensity and magnetic induction fields. The dielectric constant and specific reluctance matrices are assumed to depend on the history of the deformation gradients. The canonical forms for the constitutive equations are derived and formulae are obtained for the slowness of propagation of plane waves. These are discussed particularly in the case of time-dependent pure homogeneous deformations and shearing deformations. Author (GRA)

N71-17783# New Mexico Univ., Albuquerque. Dept. of Mechanical Engineering.

CHOICE OF MATERIALS ON THE BASIS OF RANDOM VIBRATION AND STRUCTURAL FATIGUE

H. Y. Yeh, F. D. Ju, and J. T. P. Yao May 1970 17 p refs

(Grant AF-AFOSR-0568-67)

(AD-715273; ME-44(70)AFOSR-074; AFOSR-70-2048TR) Avail: NTIS CSCL 11/6

A method is presented for the evaluation of alternative materials to be used in structures subjected to random low cycle excitation. The fracture criterion is based upon the revised Palmgren–Miner cumulative damage hypothesis in terms of plastic deformation. It is then used with a given statistics of random low cycle loading in the formulation to compute the expected value and variance of the life. As a numerical example, two aluminum alloys, one with high strength but low ductibility (2024-T4 yield strength 52 ksi and 'true strain' at fracture 0.35) and another with low strength but high ductibility (6061-T6 yield strength 25 ksi and 'true strain' at fracture 0.45) are considered as alternative materials for use in an idealized beam subjected to random excitation. In this particular case, 2020-T4 even with its higher strength gives smaller expected value of structural life to fracture. Author (GRA)

N71-17808*# Brown Univ., Providence, R.I. Div. of Engineering.

ELASTIC-PLASTIC FINITE ELEMENT ANALYSIS OF CRACKED SOLIDS Progress Report

C. Mylonas and J. R. Rice [1970] 63 p refs

(Grant NGL-40-002-080)

(NASA-CR-116513) Avail: NTIS CSCL 20K

Elastic-plastic finite element analysis is discussed. Progress and problems to date are reported on studies directed toward: 1) the analysis of practical fracture test specimens, especially the notched round tensile bar employed in the experimental program, and 2) the development of versatile singularity elements for crack tips, of a form which are readily merged with standard elements of an isoparametric or triangular type. Unanticipated difficulties have arisen in attempts at obtaining the highly accurate numerical solutions which have been a goal of the study. These are explained with a presentation of numerical results. Author

N71-17810 Lehigh Univ., Bethlehem, Pa.

TWO SPECIAL PROBLEMS IN THE THEORY OF SHELLS: 1: STRESS ANALYSIS OF THE THIN ELLIPTIC CONE. 2: ON THE STRESS ANALYSIS OF CERTAIN SANDWICH STRUCTURES

David Henry Seitz (Ph.D. Thesis) 1969 221 p

Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 70-1745

The formulation of a computerized numerical stress analysis is written for a thin shell, the reference surface of which is a two-boundary elliptic cone. The elliptic cone is a surface on which the cylindrical coordinate lines do not form an orthogonal grid. Shell equations referred to cylindrical coordinates would be non-orthogonal shell equations because the metric surface tensor has non-zero off-diagonal terms. The three-layered sandwich structure composed of two face layers with a thicker core layer between, where the face layers deform according to classical thin-shell

theory and the core is a special orthotropic continuum which develops stresses only in the direction normal to its reference surface, is subjected to numerical stress analysis by means of the multisegment method of integration of two-point boundary value problems. The equations governing the numerical solution are written for sandwich plates, beams, circular cylindrical shells and shells of revolution of arbitrary overall thickness. The solution is extremely versatile as far as choice of contraints, loads, material properties and geometries are concerned. Dissert. Abstr.

N71-17811 Lehigh Univ., Bethlehem, Pa.
STRESS DISTRIBUTION AROUND AN ARBITRARILY SHAPED OPENING IN A CIRCULAR CYLINDRICAL SHELL
A. Ziya Aktas (Ph.D. Thesis) 1969 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-1712

A method is derived for the determination of stress distribution around an opening in a circular cylindrical shell with no restriction on the shape or on the dimensions of the system. Two special assumptions are made in the derivation. The first one is that an arbitrary orthogonal coordinate system on the reference surface of a shell remains orthogonal on equi-distant surfaces when a local region of shell reference surface is considered. The second assumption is that the shape of the opening on the shell reference surface is the same as its projection on a plane tangential to the shell reference surface at a point inside the opening contour. Based on these two assumptions a set of equations is derived to be general enough to include the effect of the shell thickness and the transverse shear deformations, and also a coordinate transformation is made so that the boundary of the opening is described by one of the new coordinate lines. Dissert. Abstr.

N71-17888# Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
ADVANCED DEVELOPMENT OF LUMPED MASS, FINITE DIFFERENCE METHOD FOR DYNAMIC BEAM ANALYSIS
Robert P. Brooks 13 Nov. 1970 138 p refs
(AD-715112; NAEC-ENG-7676) Avail: NTIS CSCL 20/11

Further development of a new lumped mass, finite difference method to treat beam dynamics (including shear and moment wave travel) is presented to aid understanding and application of this method. An example problem, the C13 Steam Catapult subjected to vertical shock, shows some of the complexities, (nonlinearities, nonhomogenities, etc.), which can be treated illustrating use of the method in predictive dynamic analysis. This capability indicates the likely extension of the method to the dynamics of complex structures subjected to oblique shock loading. Author (GRA)

N71-17887# Brown Univ., Providence, R.I. Div. of Engineering.
IMPULSIVE LOADING OF FULLY CLAMPED BEAMS WITH FINITE PLASTIC DEFLECTIONS
Paul S. Symonds and Norman Jones Aug. 1970 52 p refs
(Contract N00014-67-A-0191-0003)
(AD-714885; TR-11) Avail: NTIS CSCL 20/11

A review is given of earlier work on the plastic response to impulsive loading of a beam clamped against end rotation and axial displacements, taking account of small finite transverse displacements and ofstrain rate dependence of the yield stress. New solutions are derived from rigid-plastic analysis which include both effects in simple approximate ways. Deflections are compared as obtained from these formulas, from experiments described here on mild steel beams, and from finite-difference numerical solutions using the M. I. T. rod model with elastic-plastic strain rate sensitive behavior. The significance of agreements observed is discussed. Author (GRA)

N71-17888 Stanford Univ., Calif.
ORTHOTROPIC SHELLS OF REVOLUTION WITH RAPIDLY VARYING EDGE LOADS
John Roche Kiely, III (Ph.D. Thesis) 1969 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-1557

A solution is presented for the stresses and deflections in a thin homogeneous orthotropic shell of revolution having constant thickness and subjected to edge loads which vary rapidly around the shell. The basic shell equations are reduced to an eighth order set of three homogeneous ordinary differential equations in terms of the orthogonal displacements. Approximate solutions for the displacements are assumed. Substitution of these assumed solutions into the eighth-order set yields equations from which, after a considerable amount of algebraic manipulation, the unknown displacement coefficients can be determined. The analytic solution of the problem is complete once the displacements are known, since all the stress resultants may be written in terms of these displacements. Dissert. Abstr.

N71-17925# Gulf General Atomic, San Diego, Calif.
SHELL 5: SHELL-3D VERSION 5, A COMPUTER PROGRAM FOR THE STRUCTURAL ANALYSIS OF ARBITRARY THREE-DIMENSIONAL THIN SHELLS. A USER'S MANUAL
N. Prince 30 Jan. 1970 94 p Prepared for Oak Ridge National Lab., Tenn.
(Contract W-7405-eng-26)
(GA-9952) Avail: NTIS

A user's manual is presented for a finite element program for the structural analysis of arbitrary three-dimensional thin shells. The program is written in FORTRAN 5 for the UNIVAC 1108 computer. The program requires 52,000 word core memory and auxiliary storage provided by drums and magnetic tapes. The SHELL5 program is a flexible design and analysis tool by which smoothly curved thin shell structures with any desired distribution of elastic material properties, boundary constraints, and mechanical, thermal and displacement loading conditions can be treated. Author

N71-17926# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
BENDING VIBRATIONS, AND BUCKLING OF LAMINATED ANISOTROPIC RECTANGULAR PLATES Technical Report, Apr. 1969 - Jan. 1970
James M. Whitney Aug. 1970 35 p refs
(AD-715280; AFML-TR-70-75) Avail: NTIS CSCL 20/11

Solutions are obtained for the bending, vibrations, and buckling of two special cases of laminated anisotropic rectangular plates displaying bending-extensional coupling. Three sets of boundary conditions for clamped plates, and one set of boundary conditions for simply-supported plates are considered. Plates clamped along two opposite sides and simply-supported along the two adjacent sides are also treated. Bending deflections, fundamental vibration frequencies, and buckling loads for certain orientations of angle-ply fiber reinforced composites are shown to be significantly affected by different clamped boundary conditions. Numerical results also show that the effects of bending-extensional coupling can be severe for all the boundary conditions considered. Author (GRA)

N71-17930# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.
MAXIMUM FREQUENCY OF BEAMS INCLUDING SHEAR EFFECTS
R. M. Brach and J. J. Walters Oct. 1970 22 p refs
(Contract DA-ARO(D)-31-124-G1058; DA-ARO(D)-31-124-G875)
(AD-715021; TR-70-02-04; AROD-6861-6-E) Avail: NTIS CSCL 20/11

The study considers the effect of shear deformation on the optimal design, with respect to the fundamental frequency of transverse vibration of a linear, elastic beam with a point mass attached. Since the system is conservative, Rayleighs quotient furnishes an expression for the fundamental frequency. A constraint is placed on the total mass, and the calculus of variations is then used to determine the nonlinear differential equations and the natural boundary conditions, which constitute the necessary conditions for an extremum of the frequency. As the slope of the shear deformation can be discontinuous, an additional boundary condition is secured through the Weierstrass-Erdmann corner conditions. In an effort to solve these equations the method of quasilinearization is invoked. This method provides an iterative process whereby the solution to the nonlinear equations, is found as the limit of a convergent sequence of solutions of linear equations. Author (GRA)

N71-17931# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.

BOUNDS FOR THE TORSIONAL RIGIDITY OF HEATED BEAMS

Bruno A. Boley Aug. 1970 8 p refs
(Contract N00014-67-A-0077-0009)
(AD-715076; TR-2) Avail: NTIS CSCL 20/11

The report studies the effective torsional rigidity of a beam in the presence of an axial thermal stress where the thermoelastic stress is under arbitrary temperature distribution. GRA

N71-17934# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.

APPROXIMATE ANALYSES OF THERMALLY INDUCED VIBRATIONS OF BEAMS AND PLATES

Bruno A. Boley Oct. 1970 27 p refs
(Contract N00014-67-A-0077-0009)
(AD-715077; TR-3) Avail: NTIS CSCL 20/11

A simple general formula is derived for the ratio of the maximum dynamic to static deflection of heated beams and plates. The formula, although approximate, is in good agreement with the exact results, and takes into account the effects of damping and of axial or in-plane loads. Author (GRA)

N71-17953# California Univ., Los Angeles. School of Engineering and Applied Science.

ACOUSTIC EMISSION TESTING AND MICROFRACTURE PROCESSES

Alan S. Tetelman Oct. 1970 19 p *Its* Paper Eng-0370
(Contract DAHC04-69-C-0008)
(AD-715019; TR-3; AROD-8016-3-MC) Avail: NTIS CSCL 20/11

In recent years knowledge of the mechanism of microcrack formation and propagation has increased greatly. It is now understood at least qualitatively, how plastic deformation is able to initiate cracks, how cracks are able to grow, and how large scale growth leads to macrofracture. However, there are many quantiative aspects of the microfracture process that are still not well understood. Some of these aspects may be better understood with acoustic emission testing. The report briefly describes those areas where acoustic emission testing has assisted or could assist materials scientists who are investigating microfracture processes in solids. Author (GRA)

N71-17954 Stanford Univ., Calif.

CREEP BUCKLING OF PLATES

Ilan Mosche Levi (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-1566

The effects of creep on the load carrying abilities of plates when they are loaded by compressive forces applied in the planes of the plate were studied. It was assumed that the material deforms due to linear elasticity and steady state creep, and the creep strain rate is given by the Norton-Bailey power law. When a fixed uniaxial load is applied to the plate in such a way that the load remains uniformly distributed during the buckling process, the governing equations indicate that a finite time exists after which the lateral deformations of the plate become unbounded. Simple, closed form expressions for this critical time are derived for various values of the creep exponent, and for the case where primary creep plays an important role. Dissert. Abstr.

N71-18001*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

ADVANCED SUBSTRUCTURING TECHNIQUES Interim Report

C. E. Jones 28 Dec. 1970 22 p refs
(Contract NAS8-30520)
(NASA-CR-103041; HREC-0520-1; LMSC-HREC-D162799) Avail: NTIS CSCL 20K

Digital computer programs developed for evaluating the free undamped vibrational characteristics of structural systems mathematically modeled as assemblages of arbitrary substructures are presented. Two general purpose programs were developed for implementing the substructure method. The substructure function generator program, calculates generalized displacement functions and the corresponding substructure mass and stiffness matrices for substructures mathematically modeled as an assemblage of basic beam and shell elements. The substructure synthesis program forms the system mass and stiffness matrices on the basis of input data defining substructure mass and stiffness matrices, and interconnection details. Free undamped system vibrational characteristics are computed. Author

N71-18002*# Akron Univ., Ohio.

FATIGUE CRACK PROPAGATION IN 2024-T3 AND 7075-T6 ALUMINUM ALLOYS AT HIGH STRESSES

Robert G. Dubensky Washington NASA Mar. 1971 31 p refs
(Grant NGR-36-001-010)
(NASA-CR-1732) Avail: NTIS CSCL 11F

Stable fatigue-crack-growth rates were measured at high stresses in axial-load fatigue tests on 12-inch wide sheet specimens made of 7075-T6 and 2024-T3 aluminum alloys. These tests were made at stress ratios R (ratio of the minimum stress to the maximum stress) ranging from 0 to 0.7 and at maximum stress levels ranging from 55 to 72.5 ksi for the 7075-T6 alloy and 30 to 52.5 ksi for 2024-T3 alloy. The elastic stress-intensity method was used to correlate the measured rates. In addition, a modified stress-intensity method was derived by combining Rice's cyclic stress-intensity method with the modified (for plasticity) stress-intensity method proposed by Irwin, Dugdale, and Newman. For a given R value, fatigue-crack-growth rates in 7075-T6 were nominally a single-valued function of the elastic stress-intensity range of the modified stress-intensity ranges. All curves of rate plotted against range of stress-intensity show the definite reflex curvature at the high R values in the 7075-T6 alloy and at most R values in the 2024-T3 alloy. Author

N71-18022 Rennsselaer Polytechnic Inst., Troy, N.J.

OPTIMIZATION OF COMPOSITE STRUCTURES: OPTIMUM COST AND WEIGHT DESIGN FOR A CYLINDRICAL SHELL SUBJECTED TO RE-ENTRY LOADS AND HEATING

Edgar Gebrath Menkes (Ph.D. Thesis) 1969 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-2631

An improved method of structural optimization is presented which encompasses recent advances in nonlinear mathematical programming methods and methods of analysis for fibrous composite materials. The methodology is based on a transformation of an inequality constrained minimization problem into a sequency of unconstrained minimizations, by applying a penalty function formulation. Advances include the formulation and solution of a composite shell design problem including constraints on joint-discontinuity stresses, and the development of a methodology for assessing the effects of uncertainties in system parameters on the optimum design. The optimization method is first developed by considering a classic structural design application, the redundant three bar truss. Next an application to a composite shell structure is demonstrated. Dissert. Abstr.

N71-18024 Stanford Univ., Calif.
SINGULAR SOLUTIONS FOR SHALLOW CYLINDRICAL SHELLS
Roland Dore (Ph.D. Thesis) 1969 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 70-1520

The relationships of single-valued and multi-valued singular solutions of the shallow cylindrical shell equation to some mechanical or thermal concentrated actions on the shell are considered. It is shown how a set of singular solutions can be completed in order to include the fundamental solutions for concentrated forces and also the fundamental displacement dislocations. Sixteen non-separable new solutions are obtained, five of which are single-valued and eleven multi-valued. The five single-valued solutions are identified as those for three mutually perpendicular concentrated forces and two concentrated couples. The proof that the solutions for the concentrated forces are the valid ones is worked out in detail. Dissert. Abstr.

N71-18025*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN ANALYTIC STUDY OF RADIATIVELY COOLED DELTA-WING STRUCTURES FOR HYPERSONIC AIRCRAFT
James C. Robinson, Robert W. Mc Withey, and George F. Klich Washington Feb. 1971 65 p refs
(NASA-TN-D-6138; L-6666) Avail: NTIS CSCL 01A

A thermal analysis and a stress and deflection analysis of five structural configurations for a radiatively cooled discrete delta wing were carried out by using design conditions characteristic of a Mach 8 research vehicle. The configurations included wing cover panels possessing either biaxial or uniaxial stiffness, support systems along the root chord or at two points on the root chord, and airfoil sections having either positive or negative camber. Results indicate that for configurations supported along the full root chord, no excessive thermal or airload deformations occur. However, high thermal stresses occur in the wing cover panels that possess axial stiffness in the chordwise direction. Configurations in which the cover panels possess only spanwise axial stiffness exhibit significantly lower thermal stress in the panels but require that the rib caps carry larger thermal loads. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N71-17040# Lockheed Missiles and Space Co., Palo Alto, Calif.
RADIATION HEAT EXCHANGE AT HIGH TEMPERATURES
L. M. Biberman [1970] 28 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. Transp. (USSR), no. 3, 1970 p 105–119
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The radiation characteristics of hot gases are discussed. The applicability of approximate methods of radiative transfer theory providing various methods of averaging with respect to frequency is examined. Approximate methods are considered, taking into account the spectral dependences of the real radiation characteristics. The interaction between heat conduction and convection and radiative transfer, as well as the difficulties originating in the investigation of radiative heat exchange in nonequilibrium media are discussed. Author

N71-17041# Lockheed Missiles and Space Co., Palo Alto, Calif.
INFLUENCE OF PRESSURE ON THE RADIATIVITY OF HEATED CARBON DIOXIDE GAS
E. S. Kuznetsova et al [1970] 9 p refs Transl. into ENGLISH from Teplofiz. Vysokikh. Temperatur, Akad. Nauk SSSR (Moscow), v. 8, no. 3, 1970 p 514–519
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

By using a high-temperature graphite cuvette and a medium resolution spectral apparatus, average absorption coefficients of carbon dioxide gas were measured in the 2100 to 2500/cm range at 1000 to 2000 K and 3 to 30 mm Hg. A comparison between the results obtained and existing data on the absorption coefficients at higher pressures (100 to 750 mm Hg) shows that a pressure diminution in the 2100 to 2200/cm band does not result in any noticeable diminution in the absorption coefficients. In order to extrapolate the results obtained to a gas layer with high optical thickness, regularities of the absorption in the schematized portion of the spectrum at low pressures are examined. Author

N71-17069 Leeds Univ. (England). Dept. of Physical Chemistry.
HIGH TEMPERATURE REACTION RATE DATA NO. 5: CRITICAL EVALUATION OF RATE DATA FOR HOMOGENEOUS, GAS PHASE REACTIONS OF INTEREST IN HIGH TEMPERATURE SYSTEMS
D. L. Baulch, D. D. Drysdale, and D. G. Horne Jul. 1970 61 p refs Supported by Office for Sci. and Tech. Inform.
Copyright. Avail: Issuing Activity

The following data are presented: thermodynamic data, recommended value of rate constant, Arrhenius plot and tables of available data, discussions, and references. Reactions considered are: NO2 + O = NO + O2; NO + O2 = NO2 + O; NO2 + M = NO + O + M; NO + O + M = NO2 + M; NO + O = NO2 + h nu; NO + NO + O2 = NO2 + NO2; NO2 + NO2 = NO + NO + O2. Author (ESRO)

N71-17210# National Physical Lab., Teddington (England). Div. of Chemical Standards.
SOME EQUATIONS FOR THE THERMODYNAMIC MIXING PROPERTIES OF VERY NON-IDEAL BINARY LIQUID MIXTURES
J. D. Cox Sep. 1970 35 p refs
(NPL-DCS-6) Copyright. Avail: NTIS

Ways of algebraically describing the compositional dependence of the thermodynamic properties of binary liquid mixtures that show partially miscible behavior are considered. A simple empirical equation is used to discuss activity coefficients, excess Gibbs energies of mixing, the partial miscibility of 2,6-dimethyl pyridine and water at 70 C, and solubility curves. Author (ESRO)

N71-17332# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).

PHYSICO-CHEMICAL INVESTIGATIONS DURING EXPLOSION AND COMBUSTION PROCESSES: REACTION OF CELLULOSE NITRATE WITH MAGNESIUM, BORON, AND ALUMINUM [PHYSIKALISCH-CHEMISCHE UNTERSUCHUNGEN BEI EXPLOSIONS- UND VERBRENNUNGSVORGAENGEN: REAKTION VON NITROCELLULOSE MIT MAGNESIUM, BOR UND ALUMINIUM]

R. Dautel 1 Jun. 1970 65 p refs In GERMAN (Rept-7/70) Avail: NTIS

Binary explosive mixtures of nitrocellulose and magnesium, boron, or aluminum, were thermochemically investigated. The mixtures represent model substances for explosive systems with elementary components. The results of the investigations are interpreted and discussed. ESRO

N71-17395# Arizona State Univ., Tempe.

EVALUATION OF FILM COOLING PERFORMANCE ON GAS TURBINE SURFACES

D. E. Metzger, J. R. Biddle, and J. M. Warren *In* AGARD High Temp. Turbines Jan. 1971 10 p refs (See N71-17372 07-28) Avail: NTIS HC $6.00/MF $0.95

Film cooling of gas turbine components is often characterized by relatively short cooled lengths and injection geometries which are dictated primarily by fabrication and stress considerations. For many of the resulting configurations, film cooling information based on adiabatic wall temperatures alone is inadequate for design purposes. In addition, the complexity of the film cooling process makes extrapolation of results from one injection configuration to another uncertain. A transient method is described that has been used to rapidly assess the relative performance of various film cooling configurations. Advantages as well as some inherent disadvantages of the method are discussed. The experimental facilities are described, and typical results are presented for a variety of flush, angled injection ports. Emphasis is placed on recent results obtained for high injection rates with variable injection angle, where the heat transfer is dominated by the film flow and effective heat transfer coefficients are much larger than those associated with the primary flow alone. Author

N71-17396# Rolls-Royce, Ltd., Derby (England). Aero Engine Div.

NOZZLE GUIDE VAN COOLING: THE STATE OF THE ART

G. A. Halls *In* AGARD High Temp. Turbines Jan. 1971 19 p ref (See N71-17372 07-28) Avail: NTIS HC $6.00/MF $0.95

Reviewed is the present state of the art on air cooling of nozzle guide vanes for aircraft gas turbines. It shows how the design of the cooling system, and manufacturing techniques have changed over the years to keep pace with increased turbine entry temperatures. The compromise has gradually shifted towards tailoring the design of the vane to operate within the limitations of available materials. Author

N71-17397# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).

COOLING OF TURBINE DISTRIBUTION BLADES THROUGH IMPACT EFFECT [REFROIDISSEMENT DES AUBES DE DISTRIBUTEUR DE TURBINE PAR EFFET D'IMPACT]

E. Bassinot *In* AGARD High Temp. Turbines Jan. 1971 18 p refs In FRENCH (See N71-17372 07-28) Avail: NTIS HC $6.00/MF $0.95

One of the improved methods for turbine cooling is the utilization of the impact effect in generating a discharge flow that allows very sensitive temperature corrections. Discussed are experimental studies that use slotted blades surfaces for distributing cooling air through impacting pressure and theoretical calculations of the effects of certain parameters on the impact. The experimental blade consisted of a heat resistant exterior shell and an inner lining that served as distributor of the cooling air and guided it into the convective cooling regions. The functional motor pressure provided the impact effect. It is concluded that this improved impact cooling method is suitable for distributing blades of advanced turbomachinery. Transl. by G.G.

N71-17398# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

COOLING OF TURBINE BLADES BY LIQUID METALS [REFROIDISSEMENT DES AUBES DE TURBINES PAR LES METAUX LIQUIDES]

E. Le Grives and J. Genot *In* AGARD High Temp. Turbines Jan. 1971 20 p refs In FRENCH; ENGLISH summary (See N71-17372 07-28) Avail: NTIS HC $6.00/MF $0.95

Mass transfer conditions in thermosyphon or evaporative cycles under high centrifugal acceleration are first briefly analyzed. Sodium potassium alloys are shown to be best suited on account of their heat transfer ability with air cooled exchangers at the blade roots. A high rotation speed test set-up on which the heat flux on the blades is comparable to that of a real turbine has been extensively used for an experimental study of these processes. Both cycles lead to a temperature drop as high as 650 C at the blade tips, with a mass flow rate of cooling air of 10 g. per sec. kW. However, several advantages are shown to be expectable for the evaporative cycle in view of its application to high temperature gas turbine cooling. Author

N71-17399# Army Aviation Materiel Labs., Fort Eustis, Va.

A FLUID-COOLED 2300 F ENTRY TEMPERATURE AXIAL FLOW TURBINE

Edward T. Johnson *In* AGARD High Temp. Turbines Jan. 1971 17 p refs (See N71-17372 07-28) Avail: NTIS HC $6.00/MF $0.95

A brief description of the overall program for the design and evaluation of a thermosiphon fluid-cooled axial flow turbine is given. The objective of the program was to demonstrate the thermosiphon system's capability to perform (adequately cool) at an inlet gas temperature of 2300 F. Although the original objective, cooling at 2300 F (1260 C), was achieved, difficulty was experienced in obtaining the aerodynamic efficiency, proper fabrication of the blades, and a specific horsepower of 213 HP/Wa. Despite the aforementioned problems, this program did prove the capability of the annular combustor, finned nozzle vanes and fluid-cooled blade cooling system while operating at gas temperatures of 2350 - 2450 F. Author

N71-17400# Rolls-Royce, Ltd., Derby (England). Aero Engine Div.

THERMAL FATIGUE (FILM)

In AGARD High Temp. Turbines Jan. 1971 9 p (See N71-17372 07-28) Avail: NTIS HC $6.00/MF $0.95

The incidence of thermal fatigue in cooled turbine blades is illustrated. Problems of this nature have recently been encountered and it is demonstrated how a means of overcoming such problems without resorting to expensive and time consuming rig testing can be provided. Author

N71-17404# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
TECHNOLOGICAL ASPECTS OF TURBINE BLADE COOLING BY AIR FILM [LES ASPECTS TECHNOLOGIQUES DU REFROIDISSEMENT DES AUBES DE TURBINE PAR FILM D'AIR]
Jacques M. Bertrand *In* AGARD High Temp. Turbines Jan. 1971 18 p (See N71-17372 07-28)
Avail: NTIS HC $6.00/MF $0.95

Technological aspects of placing cooling air emission holes in turbine blade tip portions are considered by evaluating mechanical blade resistance, internal duct organization resulting in an air film, and fabrication methods suitable for multiple cooling. Theoretical and experimental studies of the operational problems connected with the multiple hole cooling method for turbine blades prove the validity of the concept for application in technically advanced turbo machinery. Transl. by G.G.

N71-17502# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE CRITICAL THICKNESS OF THE HEAT INSULATION LAYER ON A CURVED SURFACE
V. S. Zarubin [1970] 4 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Mashinostro. (Moscow), no. 11, 1970 p 18–21
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

An analysis is made of the influence of the heat-insulation layer thickness on the intensity of heat transmission by the curved surface of a body to the surrounding medium. Dependences are obtained to determine the critical heat insulation layer thickness and extremal values of the heat flux for the convective and radiant heat exchange cases. Author

N71-17570*# Scientific Translation Service, Santa Barbara, Calif.
A STUDY OF THE COMBUSTION OF LAMINAR FUEL JETS
Itsuro Kimura et al Washington NASA Feb. 1971 25 p refs Transl. into ENGLISH from Tran. Jap. Soc. Mech. Eng. (Japan), v. 27, 1961 p 736–746
(Contract NASw-2035)
(NASA-TT-F-13459) Avail: NTIS CSCL 20M

The flame length of laminar fuel jets issuing into the atmosphere was analyzed, and it is shown to be proportional to the flow rate of fuel gas and inversely proportional to the diffusion coefficient of laminar fuel jets issuing into the air flowing at the same velocity; the former is about 1.5 times the latter. Experiments on gas flames in the urban air stream were conducted using normal and inverted arrangements. Experimental results show that the flame in the atmosphere is influenced by buoyancy and disturbance in the air which is caused by the combustion. The effects of buoyancy and disturbances on the flame length are discussed. Author

N71-17610* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL PUMP-COMPRESSOR FOR SPACE USE Patent
Franklin W. Booth and Hubert K. Clark, inventors (to NASA) Issued 14 Mar. 1967 (Filed 2 Apr. 1963) 4 p Cl. 230-162
(NASA-Case-XLA-00377; US-Patent-3,309,012;
US-Patent-Appl-SN-270118) Avail: US Patent Office CSCL 20M

A thermal pump-compressor for converting solar energy is described. The energy is converted into air pressure to operate pneumatic equipment. The pump comprises a solar reflector, a thermal bulb containing a volatile liquid for creating gas pressure, and a pumping means. E.C.

N71-17638# Germantown Labs., Inc., Philadelphia, Pa.
HIGH TEMPERATURE INORGANIC CHEMISTRY Annual Progress Report
R. B. Genter 28 Sep. 1970 39 p refs
(Contract AT(30-1)-4176)
(NYO-4176-3; GL-1970-12; APR-1) Avail: NTIS

Physical and chemical properties investigations of metallic elements and inorganic compounds over a broad temperature range are reviewed. Results of electrical and thermal conductivity measurements of liquid barium, and thermal conductivity data for potassium are discussed. Other topics considered include the law of the rectilinear diameter for the thermal conductivity of ideal liquids, and the diffusion coefficient, and Lewis, Schmidt, and Prandtl numbers of liquid mercury. E.C.

N71-17727# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF ENGINEERING PHYSICS, VOLUME 14, NO. 4
R. S. Mikhalchenko et al 1970 24 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSSR (Minsk), v. 12, no. 4, 1967 p 426–439
(AD-715233; FTD-HT-23-342-68) Avail: NTIS CSCL 20/13

Contents: Experimental study of the heat conductivity of laminar-vacuum insulation; and Study of the effect of mass transfer on the process of heat transfer during sublimation in a rarefied gas medium for a Couette flow. GRA

N71-17861*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIATION HEAT TRANSFER CHARACTERISTICS OF TURBINE VANE AIRFOILS IN A WATER-COOLED CASCADE
Herbert J. Gladden, Steven A. Hippensteele, Robert O. Hickel, and Robert P. Dengler Washington Mar. 1971 34 p refs
(NASA-TM-X-2203; E-5862) Avail: NTIS CSCL 20M

An analytical and experimental investigation was made to determine the net radiation heat loss from solid uncooled vanes to water cooled walls of a cascade. A thermal radiation calibration technique, based on a three-dimensional heat balance and a relatively simple experimental calibration process, was evolved. Experimental calibration studies of the thermal radiation characteristics of the vanes were made for gas temperature levels ranging from about 1460 R to 2060 R. The results showed that for the particular cascade and vane geometry investigated, a significant net radiation loss from the vanes to the cascade walls existed. Author

N71-17895# Los Alamos Scientific Lab., N.Mex.
EMPIRICAL MODEL OF HETEROGENEOUS SHOCK INITIATION OF THE EXPLOSIVE 9404
Charles L. Mader Jul. 1970 13 p refs
(Contract W-7405-ENG-36)
(LA-4475) Avail: NTIS

An empirical model that permits numerical reproduction of the gross features of the shock initiation of the heterogeneous explosive 9404 in a one-dimensional hydrodynamic code is described. The model is calibrated using available experimental data. Author

N71-17896*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BURNING OF TEFLON-INSULATED WIRES IN SUPERCRITICAL OXYGEN AT NORMAL AND ZERO GRAVITIES
Thomas H. Cochran, Donald A. Petrash, Charles R. Andracchio, and

Ray G. Sotos Washington Feb. 1971 19 p refs
(NASA-TM-X-2174; E-5895) Avail: NTIS CSCL 20M

An experimental program was conducted to investigate the burning characteristics of Teflon-insulated nickel wires in supercritical oxygen in normal and zero gravities. The zero-gravity environment was obtained in a drop tower which made available 5 seconds of test time. The results indicate that the Teflon burned in both normal and zero gravities. However, the flame propagation rate in zero gravity was smaller than in normal gravity. Author

N71-17897* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT PROTECTION APPARATUS Patent
Paul R. Hill and Otto F. Trout, Jr., inventors (to NASA) Issued 20 Sep. 1966 (Filed 19 Dec. 1962) 9 p Cl. 62-467
(NASA-Case-XLA-00892; US-Patent-3,273,355; US-Patent-Appl-SN-245941) Avail: US Patent Office CSCL 20M

A thermal protection system for application to the wing, control, and other surfaces of hypersonic aircraft and reentry vehicles is described. A fiber oriented pile is applied as a covering element to the vehicle surfaces exposed to the greatest amount of aerodynamic heating. Orientation of the fibers in the direction of airflow insures radiation away from the surfaces and eliminates penetration of the heated air below the outer face of the fibers. NASA

N71-17898*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN, PERFORMANCE, AND TEST EXPERIENCE OF FOUR MULTIHUNDRED-KILOWATT-ELECTRIC HEAT SOURCES FOR LIQUID-METAL SYSTEMS
Henry B. Block, Lawrence A. Mueller, and Fred Boecker, Jr. Washington Mar. 1971 40 p refs
(NASA-TM-X-2186; E-5986) Avail: NTIS CSCL 20M

Four different electric heaters were designed to supply the energy required for a SNAP-8 space-power-system test. Two heaters were compact units designed to physically simulate the SNAP-8 reactor thermal-dynamics. The remaining two heaters were heavy-duty units designed primarily to provide highly reliable heat sources. Heater design power was 350 kWt for the first two units constructed and 600 kWt for the last two units constructed. Heater inlet temperature was 1100 F; discharge temperature was maintained at 1300 F. Total operational time to date on all four heaters is about 4400 hours. The compact heaters had operational problems and were replaced prior to the completion of their respective tests. Experience with the compact heaters improved the heavy-duty heaters' final design. The heavy-duty heaters were used during most of the testing and were considered successful. Author

N71-17899*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SHOCK-TUBE THERMOCHEMISTRY TABLES FOR HIGH-TEMPERATURE GASES. VOLUME 4: NITROGEN
W. A. Menard and T. E. Horton (Miss. Univ.) 1 Dec. 1970 65 p refs
(Contract NAS7-100)
(NASA-CR-116444; JPL-TR-32-1408) Avail: NTIS CSCL 20M

Thermodynamic properties and species concentrations of equilibrium nitrogen are tabulated for moving, standing, and reflected shock waves. Initial pressures range from 0.05 to 50.0 torr, and temperatures from 2000 to over 75,000 K. Author

N71-17900*# Martin Marietta Corp., Denver, Colo. Space Systems Dynamics Unit.
AEROSPACE SYSTEMS PYROTECHNIC SHOCK DATA: GROUND TEST AND FLIGHT. VOLUME 1: SUMMARY AND ANALYSIS Final Report, Jun. 1968–Mar. 1970
William J. Kacena, III, M. B. McGrath, and W. P. Rader 7 Mar. 1970 348 p refs
(Contract NAS5-15208)
(NASA-CR-116437) Avail: NTIS HC $6.00/MF $0.95 CSCL 19A

A compilation of the shock loads on spacecraft structures which are produced by pyrotechnic and explosive devices during component separation is presented. Subjects discussed are: (1) compilation of reduced pyrotechnic shock data representative of aerospace systems, (2) definition of distinctive characteristics of pyrotechnic shock transients, (3) evaluation of the quality of typically available pyrotechnic shock data, and (4) preparation of guidelines defining design information applicable to structure and/or equipment design. Author

N71-17901*# Martin Marietta Corp., Denver, Colo. Space Systems Dynamics Unit.
AEROSPACE SYSTEMS PYROTECHNIC SHOCK DATA: GROUND TEST AND FLIGHT. VOLUME 2: DATA Final Report, Jun. 1968–Mar. 1970
William J. Kacena, III, M. B. McGrath, and W. P. Rader 7 Mar. 1970 618 p
(Contract NAS5-15208)
(NASA-CR-116450) Avail: NTIS HC $6.00/MF $0.95 CSCL 19A

Pyrotechnic shock data associated with structure cutting charges such as mild detonating fuse and flexible linear shaped charge are presented. Subjects discussed are: (1) explosive nuts and bolts, (2) cartridge actuated devices such as pin pullers and cable cutters, (3) tests on Spartan missile, Minuteman ICBM, and Centaur launch vehicles, and (4) shock data from flight events. Author

N71-17902*# Martin Marietta Corp., Denver, Colo. Space Systems Dynamics Unit.
AEROSPACE SYSTEMS PYROTECHNIC SHOCK DATA: GROUND TEST AND FLIGHT. VOLUME 3: DATA Final Report, Jun. 1968–Mar. 1970
William J. Kacena, III, M. B. McGrath, and W. P. Rader 7 Mar. 1970 719 p ref
(Contract NAS5-15208)
(NASA-CR-116401; MCR-69-611-Vol-3) Avail: NTIS HC $9.00/MF $0.95 CSCL 20M

A series of various confidence tests were performed on the Polar Orbiting Geophysical Observatory (POGO). The shock testing phase was conducted to determine the shock loads on the spacecraft and the spacecraft adapter ring due to shroud separation. Author

N71-17903*# Martin Marietta Corp., Denver, Colo. Space Systems Dynamics Unit.
AEROSPACE SYSTEMS PYROTECHNIC SHOCK DATA: GROUND TEST AND FLIGHT. VOLUME 4: LOCKHEED DATA AND ANALYSES Final Report, Jun. 1968–Mar. 1970
William J. Kacena, III, M. B. McGrath, and W. P. Rader 7 Mar. 1970 657 p refs
(Contract NAS5-15208)
(NASA-CR-116402; MCR-69-611-Vol-4) Avail: NTIS HC $9.00/MF $0.95 CSCL 20M

A compilation of data resulting from investigations of shock loads on spacecraft structures produced by the operation of pyrotechnics and explosive devices used to separate spacecraft components is presented. Subjects discussed are: (1) separation

joints, (2) fairing jettisoning, (3) pin actuators, (4) external payloads, (5) electronic box testing, and (6) shock testing devices. A total of 445 shock spectra and 955 oscillograms are included. Author

N71-17904*# Martin Marietta Corp., Denver, Colo. Space Systems Dynamics Unit.
AEROSPACE SYSTEMS PYROTECHNIC SHOCK DATA: GROUND TEST AND FLIGHT. VOLUME 5: LOCKHEED DATA AND ANALYSES Final Report, Jun. 1968 – Mar. 1970
William J. Kacena, III, M. B. McGrath, and W. P. Rader 7 Mar. 1970 577 p refs
(Contract NAS5-15208)
(NASA-CR-116403; MCR-69-611-Vol-5) Avail: NTIS HC $6.00/MF $0.95 CSCL 20M

Shock loads induced on spacecraft structures by initiation of explosive pin pullers are discussed. Various isolation methods to reduce the shock environment are described. Principal shock reduction techniques are: (1) isolating silicon rubber washers, (2) an energy absorbing snubber, and (3) a force limiting spring bracket. The force limiting spring bracket provides most successful shock reduction. Author

N71-17905*# Martin Marietta Corp., Denver, Colo. Space Systems Dynamics Unit.
AEROSPACE SYSTEMS PYROTECHNIC SHOCK DATA: GROUND TEST AND FLIGHT. VOLUME 6: PYROTECHNIC SHOCK DESIGN GUIDELINES MANUAL, REVISION A Final Report, Jun. 1968 – Mar. 1970
William J. Kacena, III, M. B. McGrath, and W. P. Rader 7 Mar. 1970 37 p
(Contract NAS5-15208)
(NASA-CR-116406) Avail: NTIS CSCL 19A

A set of guidelines defining design information applicable to structure and/or equipment for designing to a pyrotechnic shock environment is presented. These guidelines include a description of various pyrotechnic devices and associated shock levels near the source. Attenuation curves for a variety of structures are included and methods of isolating equipment from a shock environment are discussed. Author

N71-17924# California Univ., Berkeley. Lawrence Radiation Lab.
LOW-TEMPERATURE HEAT CAPACITIES OF DILUTE SOLUTIONS OF Fe AND Cr IN Cu
B. B. Triplett and Norman E. Phillips Aug. 1970 7 p refs Presented at the 12th Intern. Conf. on Low Temp. Phys., Kyoto
(Contract W-7405-eng-48)
(UCRL-19686; CONF-700921-2) Avail: NTIS

Heat capacity measurements on Cu-Cr samples give (1.05 + or – 0.10) Rln4 for the entropy associated with the formation of the Kondo state. On the high-temperature side of the anomaly the Cu-Fe data are less accurate but are also consistent with an entropy of Rln4. The field dependence of the heat capacity suggests that the T sup 1/2 term in the susceptibility is associated with Fe-Fe interactions. Author

N71-17955*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYDRODYNAMIC ENTRANCE EFFECT ON BOILING AND NEAR CRITICAL HYDROGEN HEAT TRANSFER
S. Stephen Papell and Dwight D. Brown Washington Feb. 1971 48 p refs
(NASA-TN-D-6159; E-5125) Avail: NTIS CSCL 20M

Heat transfer data were obtained from test sections designed with fully developed flow (straight) inlets and undeveloped flow (plenum) sharp edge inlets. In the boiling regime, inlet hydrodynamics influenced the transition from nucleate to film boiling over the entire test section length while film boiling was influenced up to about 4 to 8 diameters from the inlet. The near critical data showed that, in comparison to the fully developed inlet conditions, the plenum inlet could raise the heat transfer rates over the entire test section length with differences in the data increasing with heat flux and decreasing with Reynolds number. An equation that comprehends fully developed inlet flow, modified to correlate the plenum data, showed an average increase of 57 percent in the heat transfer rates. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N71-17043# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS, SEPTEMBER 1970
Sep. 1970 49 p refs
(PB-195154) Avail: NTIS CSCL 14B

Complete article: Influence of size effect on low-temperature electrical resistivity. Summaries are given of research in the following fields: acoustics, electronics, mathematics, metallurgy, optics, radar. Also, an abstract is included on electrolytic etching sputtered thin films of Pt, Pd, and Au. GRA

N71-17159# EUROSPACE, Paris (France).
INTRODUCTION TO THE THEMES OF THE 4TH EUROSPACE US-EUROPEAN CONFERENCE
Jean Cahen Salvador 1970 8 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22 – 25 Sep. 1970
Avail: NTIS

European cooperation in future US space programs (e.g. space shuttles and space missions) and the development of European application satellite systems with possible US industrial contributions are discussed. ESRO

N71-17180# Eurospace, Paris (France).
THE CASE FOR US-EUROPEAN COOPERATION IN THE FUTURE US SPACE PROGRAMME
Jun. 1970 42 p
Avail: NTIS

The invitation for European participation in the NASA Post-Apollo space station, shuttle, and tug projects may call for contributions of $2 billion spread over a decade. Four possible programs are discussed and necessary urgent studies are listed. ESRO

N71-17181# Oerlikon Machine Tool Works, Zurich (Switzerland).
PROSPECTUS FOR A EUROPEAN COMPANY WITH REGARD TO THE OPERATION OF REGIONAL APPLICATION SATELLITE SYSTEMS
P. L. Burckhardt 1970 9 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22 – 25 Sep. 1970
Avail: NTIS

Major ESRO projects proposed to European government, e.g. telecommunication, air traffic, and meteorological satellites, are outlined. The importance of creating regional application satellite systems and a European company (EUROSAT) are emphasized. Problems are analyzed and solutions suggested. ESRO

N71-17182# Etudes Techniques et Constructions Aerospatiales, Charleroi (Belgium).
EUROPEAN INDUSTRY AND SPACE 1970: ASSESSMENT OF US-EUROPE COOPERATION
M. Desirant 1970 13 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22–25 Sep. 1970
Avail: NTIS

The evolution of the aerospace industries in Europe and America is described. Political divergencies, lack of financial support, and lack of experience are discussed and solutions proposed. ESRO satellite and ELDO launch vehicle programs are discussed as examples of European industrial participation and Intelsat as one of US-European collaboration. Possible European industrial participation in the Post Apollo program is outlined. ESRO

N71-17215# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
PARTICIPATION OF US INDUSTRY IN THE EUROPEAN APPLICATION SATELLITES PROGRAM
E. O. Marriott 1970 18 p Presented at the 4th EUROSPACE US-European Conf., Venice, 22–25 Sep. 1970
Avail: NTIS

Previous participation in joint programs such as Intelsat 3 and 4 are recalled. Various combinations of US-European cooperation in the fields of design, fabrication, and testing are discussed. ESRO

N71-17531# Congress. House. Committee on Science and Astronautics.
SUMMARY OF ACTIVITIES OF THE SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT, 1963–1970
Emilio Q. Daddario Washington GPO 1970 98 p refs Presented to the Comm. on Sci. and Astronaut., 91st Congr., 2d Sess., 15 Dec. 1970
Avail: Subcomm. on Sci., Res., and Develop.

Data presented are in topical form and to a considerable extent in chronological order. The nature of each activity, the action taken, and the effects of such action are described. Topics include: Federal science policy, funding and geographical distribution of Federal R and D programs, aeronautics, science education, the National Science Foundation, information systems, standards, environmental quality, fire research, technology assessment, management of Federal scientific activities, international science, and multidisciplinary or systems studies. Author

N71-17532# Congress. House. Committee on Science and Astronautics.
ESTABLISHING THE OFFICE OF TECHNOLOGY ASSESSMENT AND AMENDING THE NATIONAL SCIENCE FOUNDATION ACT OF 1950
Emilio Q. Daddario Washington GPO 1970 25 p refs Rept. to accompany H.R. 18469 presented by the Comm. on Sci. and Astronaut. to the Comm. of the Whole House on the State of the Union, 91st Congr., 2d Sess., 9 Sep. 1970
(Rept-91-1437) Avail: US Capitol, House Document Room

The committee's favorable recommendation on H.R. 18469 is reported. The purpose of the bill is to establish an Office of Technology Assessment for the Congress as an aid in the identification and consideration of existing and probable impacts of technological application, and to amend the National Science Foundation Act of 1950, as amended, to conform therewith. Author

N71-17632# Committee on Armed Services (U.S. House).
REVIEW OF INDEPENDENT RESEARCH AND DEVELOPMENT PROGRAM MANAGEMENT From Armed Services Investigating Subcommittee, 11 Sep. 1970
Washington GPO 1970 25 p refs Rept. under the authority of H. Res. 105 presented by the Comm. on Armed Serv., 91st Congr., 2 Sess., 18 Sep. 1970
Avail: US Capitol, House Document Room

The review contains observations on Independent Research and Development (IR and D) in industry, Department of Defense support of IR and D in industry, and Department of Defense policies and management techniques for protecting Government interests in IR and D. Topics discussed include: IR and D costs in defense procurement, management and control of IR and D programs, and accounting, negotiation, and coordination problems, as well as those met in complying with IR and D fund ceilings. E.C.

N71-17726# Office of The Director of Defense Research and Engineering, Washington, D.C. Office for Lab. Management.
THE DEFENSE IN-HOUSE LABORATORIES
E. M. Glass 15 Sep. 1970 73 p refs
(AD-715213; MAR-70-1) Avail: NTIS CSCL 14/2

The Center for Strategic and International Studies at Georgetown University is conducting a broad study on U.S. R and D Management. This report was prepared to review the issues pertaining to the Defense inhouse laboratories and provide a historical perspective for the period 1961-1970. The review covers the problems identified, the actions taken, the problems that are still evident, and the various options available to make these organizations more effective. The interpretation of historical events given here and the options described are presented to stimulate discussion and dialogue concerning the important matter of in-house governmental laboratories. As such, they do not necessarily coincide with the official views of the Department of Defense. Author (GRA)

N71-17778 Duke Univ., Durham, N.C.
SOME EFFECTS OF SPACE SCIENCE MATERIALS UPON STUDENT ACHIEVEMENT IN MATHEMATICS
Alvin Grant Myrick (Ph.D. Thesis) 1969 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-2161

High school students in Algebra 2 were introduced to examples of mathematics from space science applications. Space-related publications were made available for use outside of class. Selections from a space-related mathematics resource book, being prepared for NASA, were tried out for effectiveness towards stimulation of student interest and improved achievement. The effects of the mathematical examples and printed materials were assessed by statistical analyses. Achievements were compared in and between control and treatment classes for the higher and lower IQ groups and sex groups. The achievement of the treatment class was greater (significant at the .05 level) than that of the control class. The treatment was more effective with the boys and with the higher IQ group. The effect of IQ on achievement was significant, but the improvement in achievement was not linear or uniform over IQ. Dissert. Abstr.

N71-17779# Civil Aeronautics Board, Washington, D.C.
REMARKS PREPARED FOR DELIVERY BEFORE THE 1970 ATA ENGINEERING AND MAINTENANCE CONFERENCE
Secor D. Browne 7 Oct. 1970 8 p Conf. held at Atlanta, Georgia, 7 Oct. 1970
Avail: Issuing Activity

The status of certain operational and administrative issues in civil aeronautics is summarized. Topics cited include: route systems, scheduling, air traffic control, air space and terminal congestion, noise control, SST development, and air fare rates. E.C.

N71-17798# Civil Aeronautics Board, Washington, D.C.
CIVIL AERONAUTICS BOARD CAREERS FOR ECONOMISTS AND TRANSPORTATION INDUSTRY ANALYSTS
[1970] 12 p
Avail: Issuing Activity

Economist and air transportation analyst employment opportunities and qualification specifications are outlined. Employee benefits provided by the Civil Aeronautics Board are summarized. E.C.

N71-17799# Civil Aeronautics Board, Washington, D.C.
REMARKS TO THE EXECUTIVE PROGRAM ON TRANSPORTATION AND LOGISTICS
Secor D. Browne 6 Aug. 1970 12 p Conf. held at Boston, 6 Aug. 1970
Avail: Issuing Activity

The following topics are considered: air piracy prevention, effects of reductions in air passenger capacity, controlling labor costs, smoke and noise control, air traffic control procedure revisions, and airways congestion. An edited transcript of the question and answer session is also presented. E.C.

N71-17843*+ Georgia Inst. of Tech., Atlanta.
INTERURBAN AIR TRANSPORTATION SYSTEM: A GRADUATE PROJECT IN COMPLEX SYSTEMS DESIGN, PRESENTED BY THE STUDENTS OF AE-EE-ME 655-656 (WINTER-SPRING QUARTERS, 1969)
Cassius Mullen, ed. Dec. 1969 409 p refs
(Grants NGT-11-002-064; NGR-11-002-081; NSF GU-2161)
(NASA-CR-116431) Avail: NTIS HC$6.00 CSCL 01E

A systems approach was used to study the interurban public air transportation problem for the 1975 to 1985 period. The nature of this problem was determined, alternate solutions were posed and measures of effectiveness and cost were applied. Basic areas of demand and route structure, air vehicles, terminals and ground facilities, and air traffic control were used to formulate a mathematical model for common carrier air transportation in the United States of America. Author

N71-18004# Civil Aeronautics Board, Washington, D.C.
CAREERS FOR ACCOUNTANTS AND AUDITORS
[1970] 9 p
Avail: Issuing Activity

Employment as an accountant or auditor for the Civil Aeronautics Board is discussed with respect to academic requirements, experience, salary, and promotion opportunities. R.B.

N71-18016# Committee on Armed Services (U. S. House).
INDEPENDENT RESEARCH AND DEVELOPMENT
Washington GPO 1970 276 p refs Hearings under the authority of H. Res. 105 before the Comm. on Armed Serv., 91st Congr., 2d Sess., 15–16 Feb. and 2 Mar. 1970
Avail: Armed Services Investigating Subcomm.

Congressional testimony is reported for hearings on independent research and development, which is defined as contractor efforts not sponsored by Government contract, grant, or other support. R.B.

N71-18017 RAND Corp., Santa Monica, Calif.
PREFERENCES FOR MULTI-ATTRIBUTED ALTERNATIVES
Howard Raiffa Apr. 1969 115 p refs
(Contract DOT-3-0008)
(RM-5868-DOT/RC) Copyright. Avail: Issuing Activity

Several techniques are presented for assessing the utility of complex alternatives, including the problem where each alternative can be described by a series of attributes which are interdependent in various ways. A hierarchical structuring procedure for obtaining a relevant list of attributes is described and examples are given from transportation and medical treatment problems. Each alternative or consequence is assumed to be described by a sequence of numbers or numeraires, with the i-th number interpreted as its score or performance on the i-th attribute. The basic problem is to assess a utility function over an r-tuple of numeraires. Author

N71-18026# TRW Systems Group, Redondo Beach, Calif.
TRAVEL TIME REDUCTIONS AND ENERGY SAVINGS FOR GRAVITY-AUGMENTED EVACUATED TUBE VEHICLE SYSTEMS
M. King, R. Simms, and J. W. Smylie Jan. 1970 39 p refs
(Contract C-353-66)
(PB-190396; TRW-06818-6035-R0-00) Avail: NTIS

Vehicle passengers going down an incline do not perceive the acceleration along the path due to gravity. Only the acceleration from propulsive thrust is felt. This phenomenon permits vehicles using inclined paths to travel at a shorter travel time than on the horizontal without exceeding acceleration comfort criteria. Vehicles operating in tunnels experience more aerodynamic drag magnification than vehicles operating in the open. The quantitative effects that gravity has on travel times and energy for evacuated tube vehicle systems are examined. Stage lengths of 3 to 10 miles, typical of urban applications, and lengths of 40 to 100 miles, typical of interurban applications, were considered. Author

N71-18039# TRW Systems Group, Redondo Beach, Calif.
STATE-OF-THE-ART TUBE VEHICLE SYSTEM
M. King and J. W. Smylie Jun. 1970 55 p refs
(Contract C-353-66(NEG))
(TRW-06818-6042-R0-00) Avail: NTIS

A state-of-the-art train operating in a low pressure (3.5 psia) underground tunnel is analyzed. The tunnel is smaller and deeper (200 to 500 feet) than most subways. The additional depth enhances propulsion during acceleration and braking during deceleration. Such a system can be constructed from state-of-the-art equipment with minor modifications. The reduction in tunnel size and cost offsets the additional cost of vacuum pumps of conventional urban systems, while at the same time energy costs are reduced. The system speed is great enough to provide high capacity as a shuttle service utilizing a single tube, which may have application in an airport access link. Author

N71-18040# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
EXECUTIVE SUMMARY OF ANALYTICAL STUDY OF AIR TRAFFIC CAPACITY IN THE NEW YORK METROPOLITAN AREA AND NEW YORK AIR TRAFFIC CAPACITY STUDY (REAL TIME SIMULATION) Final Reports
Feb. 1970 15 p
(FAA-RD-70-7; FAA-RD-70-4; FAA-NA-70-15) Avail: NTIS

The air traffic system capacity in the New York Metropolitan Area was examined. The effects of adding runways at Kennedy International and Newark Airports and the use of standardized instrument arrival and departure procedures, a revised route structure based on area navigation capability, and automated control aids and regulating traffic are estimated. Estimates were derived from a dynamic real-time simulation study and an analytical study covering system aspects not amenable to dynamic simulation. Estimates include: practical annual capacity, severe congestion annual capacity, and airspace system capacity in terms of controller workload and airspace physical capacity. Author

N71-18041# Creighton, Hamburg, Inc., Bethesda, Md.
SOME APPLICATIONS OF ACG/DIME FILES IN TRANSPORTATION AND REGIONAL PLANNING
2 Feb. 1970 35 p refs
(DOT Order PS-00009)
(PB-191488) Avail: NTIS

Applications of the Bureau of Census address coding guide (ACG/DIME) to Department of Transportation problems is discussed. Emphasis is placed on the use of ACG/DIME in preparing network inputs to traffic and other simulation models, and as the basis for a hierarchical data aggregation and display system. The use of ACG/DIME for travel surveys and highway and land use inventories is also discussed. E. C.

N71-18070# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
CASE STUDIES OF ONR SUPPORTED RESEARCH
Edward I. Salkovitz, Ronald W. Armstrong, and John P. Howe Oct. 1970 98 p refs
(Contract DAHC15-67-C-0011)
(AD-714860; RP-P-645; IDA/HQ-70-11545) Avail: NTIS CSCL 5/1

The purpose of the paper is to improve knowledge about the conduct of basic research programs on the basis of experience gathered in four Material Science programs: (1) Molybdenum and other refractory metals; (2) Boron components and inorganic polymers; (3) Cryogenics; (4) Dislocations. The historical beginnings of these programs are discussed; the development and evolution of the programs and their eventual technological and scientific importance are reviewed. It is found that all four programs were well selected and well managed; that interaction with the academic community was considerable; that the four programs had great impact on university curricula; that technology has benefited; that the research was sound and attracted outstanding researchers; and that the program trained students who have developed to become managers in DOD, NSF, AEC, and NASA. It is concluded that it may be possible to define and utilize criteria to measure probable success of a planned research program. It is also concluded that the determination of sequential steps and goals is necessary to a successful program and that it is possible to determine when a research program should be terminated. It is further concluded that adequate communication between science researcher and potential user of new knowledge does not now exist. It is recommended that new mechanisms should be established whereby scientists and engineers exchange information and help to guide research programs. Author (GRA)

N71-18071# Congress. Senate. Committee on Public Works.
REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY
Washington GPO 1970 27 p refs Hearing before Comm. on Pubic Works, 91st Congr., 2d Sess., 11 Aug. 1970
Avail: Subcomm. on Air and Water Pollution

Findings and recommendations of the President's Council on Environmental Quality relate to air and water pollution problems. Measures for restricting construction of new power plants, for reducing aircraft noise levels and for controlling automobile exhaust products are emphasized. G.G.

N71-18072# Department of Transportation, Washington, D.C.
NATIONAL TRANSPORTATION PLANNING MANUAL (1970 – 1990). MANUAL A: GENERAL INSTRUCTIONS
Jul. 1970 187 p
(PB-194984; BOB-004-S700028) Avail: NTIS

General instructions are given on how to present and summarize cooperative comprehensive and continuing planning for the economic development of a national transportation system. The overall process covers all modes of domestic transportation and includes both private and public sectors of the economy. G.G.

N71-18073# Commerce Dept., Washington, D.C.
GOVERNMENT AND TECHNOLOGY: THE CHALLENGE OF THE 70's
Myron Tribus 1970 12 p Presented at the 55th Ann. Meeting of the Natl. Conf. on Weights and Meas., Salt Lake City, 14 Jul. 1970
Avail: Issuing Activity

Cooperation involving State, local, and Federal governments and the private sector is advocated to keep the technological society running and to smooth the interface between technology and society. Emphasis is placed on the distribution of wealth and its creation by the growth of technology. G.G.

N71-18078# Civil Aeronautics Board, Washington, D.C.
REMARKS PREPARED FOR DELIVERY BEFORE THE ASSOCIATION OF LOCAL TRANSPORT AIRLINES FALL QUARTERLY REGIONAL MEETING
Secor D. Browne 28 Sep. 1970 8 p Conf. held at Anchorage, Alaska, 28 Sep. 1970
Avail: Issuing Activity

The present state of local air transport and the main aspects to be considered in deciding future transport service are briefly discussed. The topics mentioned include the following: current economic plight of local airlines; the new Class Rate 5 formula being developed; the need for cooperation between local representatives, Systems Analysis Research Corporation, and the Civil Aeronautics Board; Mutual Aid Pact; encouragement of industries to locate away from urban areas; suitability of serving all existing points on routes where there is competition; fares; and marketing departments. N.E.N.

N71-18079# Civil Aeronautics Board, Washington, D.C.
REMARKS PREPARED FOR DELIVERY BEFORE THE 1970 NATIONAL AIRPORTS CONFERENCE
Secor D. Browne 6 Oct. 1970 6 p Conf. held at Norman, Okla., 6 Oct. 1970
Avail: Issuing Activity

The airport community noise problem and ways of noise reduction are discussed. The retrofit programs were examined and found to be high in cost and dubious in outcome. Suggestions were made to the FAA, which could be implemented immediately and cut noise exposure up to 90%: raise the approach floor of the ILS system 3000 feet and change the departure noise abatement procedures to allow pilots to take full advantage of the jet transport climb capability. It is also felt that effort should be spent on producing new, quiet, clean engines in the 20,000 to 30,000 pound thrust class. N.E.N.

N71-18080# National Aeronautics and Space Administration, Washington, D.C.
SELECTED PROFESSIONAL AND TECHNICAL FILMS
Feb. 1971 40 p
(NASA-TM-X-66710) Avail: Available to NASA Offices and Centers from the NASA Facility. All other request for the document must be forwarded to NASA Headquarters, Code FAM, Washington, D.C. 20546 CSCL 05B

A list is presented of NASA films suitable for showing to audiences at professional, technical or advanced educational levels with adequate backgrounds in the scientific-technical fields. The films are listed in the following categories: (1) calibration, (2) scientific and engineering experiments, (3) NASA facilities, (4) reliability and quality assurance, (5) technology and technology utilization, and (6) NASA programs and operations. Instructions, and addresses for borrowing the prints are included. Author

N71-18081# TRW Systems Group, Redondo Beach, Calif.
A COMPUTER-ASSISTED METHOD FOR OPTIMIZING ROUTE PROFILES Final Report
Dec. 1969 89 p
(Contract C-353-66(NGE))
(TRW-06818-W004-R0-00; FRA-RT-70-31) Avail: NTIS

A heuristic approach is described for estimating the cost of constructing a route along a given path. Specifically, a computer program is developed to perform cost computation for a given road profile, taking into account the earthwork as well as elevated structures and tunnels. The user inputs the trial profiles, the constraints, and the changes. Use is made of a time-sharing remote terminal so that the user can interact with the computer to manually perform the optimization. The program performs all cost calculations, accepts data and modifications, edits road profiles and prints out diagnostics when necessary. Author

N71-18082# TRW Systems Group, Redondo Beach, Calif.
ELEVATED GUIDEWAY STRUCTURES Final Report
Dec. 1969 13 p refs
(Contract C-353-66(NEG))
(TRW-06816-W005-R0-00; FRA-RT-70-35) Avail: NTIS

The problem of elevated guideway structures employing simply-supported beams and spread footing is studied. Various structural materials and components are considered. On the basis of static analysis, practical information about the design requirements has been generated. Cost data are also provided. Results are displayed in convenient graphical form, for span length up to 100 feet and maximum deflection up to 0.1 foot. Author

N71-18087# Commerce Dept., Washington, D.C.
NATIONAL EXPORT EXPANSION COUNCIL: REPORT OF THE INDUSTRY COMMITTEE ON COMMERCIAL AIRCRAFT
Robert J. Murphy, Jr. May 1970 38 p
Avail: Issuing Activity

Civil aircraft export strategy and recommendations for increased exports during the 1970's are discussed. It is pointed out that significant competition comes not only from the United Kingdom but also from Japan and the USSR. It is felt that to meet the increased competition, industry and Government must work closely together and adequate long term financing will be crucial. Financing from the Export-Import Bank, commercial banks, and Government is recommended. It is also considered that overseas procurement and production, and politico/military policies should be reviewed. N.E.N.

N71-18093# Institute of Transport Aviation, Paris (France).
TRAFFIC FORECASTS, FLEET OPTIMIZATION, PLANNING WITHIN ENTERPRISES [PREVISION DE TRAFIC, OPTIMISATION, DES FLOTTES, PLANIFICATION D'ENTREPRISE]
1970 70 p refs Meeting held at Paris, 29 May 1970
(Rept-1970/7-E) Avail: NTIS

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2. FLEET OPTIMIZATION METHODS J. Agard (Air France, Paris) p 15–35 refs (See N71-18095 07-34)
3. TRAFFIC FORECASTS J. D. Blanchet (Secretariat Gen. A l'Aviation Civile, Paris, France) p 37–57 refs (See N71-18096 07-34)
4. PLANNING WITHIN THE ENTERPRISES BELONGING TO THE AVIATION ECONOMIC CYBERNETICS GROUP J. Arnaud (Air Inter, Lignes Aeriennes Interieures, Paris, France) p 59–67 (See N71-18097 07-34)

N71-18094# Institute of Transport Aviation, Paris (France). Air Transport Div.
ORIGIN AND WORK OF THE GCEA
T. Baumgart *In its* Traffic Forecasts, Fleet Optimization, Planning within Enterprises 1970 p 7–14 (See N71-18093 07-34)
Avail: NTIS

The international aviation cybernetics-economic study group examines the working methods of a number of economic research bodies belonging to airlines, aircraft manufacturers, airport authorities and the US Administration. Discussed are air traffic forecasts, air fleet optimization model formations, and company planning and decision making methods. G.G.

N71-18095# Air France, Paris.
FLEET OPTIMIZATION METHODS
J. Agard *In* Inst. of Transport Aviation Traffic Forecasts, Fleet Optimization, Planning within Enterprises 1970 p 15–35 refs (See N71-18093 07-34)
Avail: NTIS

Complex fleet selection and allocation studies for air transport estimates include economic calculations and operational research. Mathematical models and computer simulations are used to select the best aircraft after estimating a traffic segment, lowest aircraft operating costs in a given range of qualities, and fleet network needs. Optimization criteria for the mathematical decision models include: (1) maximization of profit; (2) ideal growth in turnover; (3) quality of service; (4) regularity of annual investment; (5) homogeneity of fleets; (6) a positive balance in foreign currency; (7) regular employment; and (8) good industrial development. G.G.

N71-18096# Secretariat General a l'Aviation Civile, Paris (France). Air Transport Div.
TRAFFIC FORECASTS
J. D. Blanchet *In* Inst. of Transport Aviation Traffic Forecasts, Fleet Optimization, Planning within Enterprises 1970 p 37–57 refs (See N71-18093 07-34)
Avail: NTIS

Long, medium or short terms for air traffic planning estimates are evaluated and the advantages of a cyclical overhaul each year are outlined. Planning includes an analysis of internal and external factors with an explanation for the differences between forecasts and results and the translation of general policy into management objectives and decisions. The work takes place through the decision year n for the detailed preparation of year n + 1; implementation of the plan includes inevitable corrections by means of differentials and correlations with budgeting and control panel data. G.G.

N71-18097# Air Inter, Lignes Aeriennes Interieures, Paris (France).
PLANNING WITHIN THE ENTERPRISES BELONGING TO THE AVIATION ECONOMIC CYBERNETICS GROUP
J. Arnaud *In* Inst. of Transportation Aviation Traffic Forecasts, Fleet Optimization, Planning within Enterprises 1970 p 59–67 (See N71-18093 07-34)
Avail: NTIS

Forecasting needs in the air transport field are recognized in market research and econometric approach. The former studies traffic generated by different groups of potential travellers, who are grouped by geographical region, purpose of travel, company departments, etc.; behavior of each group is assessed with varying degrees of accuracy, generally by extrapolating that previously recorded by means of surveys. The economics approach tries to explain traffic through mathematical modeling by bringing in exogenous variables for which the trends are better known than the trends in the variable being studied. The accuracy of both methods on the quality of statistical information available. G.G.

N71-18100# Institute of Transport Aviation, Paris (France).
ATTITUDES TAKEN WITH REGARD TO AMENDMENTS TO THE WARSAW CONVENTION [LES PRISES DE POSITION AU REGARD DES AMENDEMENTS A LA CONVENTION DE VARSOVIE]
H. Beaubois 1970 58 p refs
(Rept-1970/8-E) Avail: NTIS

An investigation is presented on the attitudes of members towards the revised limits of liability to international air transport passengers, as fixed by the Warsaw Convention and amended by The Hague Protocol. The positions adopted, in light of proposed amendments, since the first meeting of the ICAO Legal Committee in 1968, and how the different viewpoints evolved before crystallizing in the conclusions finally formulated by the Legal Committee itself are studied. The proposed amendments primarily concern the following six points: laws governing liability in passenger transport and means of defence open to the carrier; financial limitations on liability, and possible exceptions; the limit sum or sums; revising the limit sum; legal costs; and jurisdictional competence. The discussions pursued during 1968, 1969, and 1970 stemmed from the initial stands adopted and made known to the Subcommittee by IATA and the US Government. Their arguments are set out in detail after the more pertinent comments formulated by the Subcommittee's panel of experts are mentioned. The stands adopted by certain delegations throughout the legal Committee's labors on the six points are explained. Author

N71-18102# TRW Systems Group, Washington, D.C.
HIGH-SPEED GROUND TRANSPORTATION SYSTEMS ENGINEERING STUDY. TRAIN ELEVATED GUIDEWAY INTERACTIONS
A. Kaplan, N. Kipner, F. B. Roberts, and R. O. Strom Feb. 1970 141 p refs
(Contract DOT-C-353-66(Neg))
(PB-190635; TRW-06818-6036-R0-00; FRA-RT-70-23) Avail: NTIS

A computer program modeling the response of an elevated guideway to the passing of a high-speed train is described. The train is modeled by a lumped parameter dynamic system. The model consists of a two-vehicle train, traveling at constant velocity over a series of similar, simply-supported bridges which may have initial camber. The response of the bridge is represented as the sum of normal mode responses. These are coupled to the equations of motion governing the response of the vehicles. The resultant system of equations is numerically integrated from arbitrary initial conditions. For evenly-spaced time intervals, depending on the size of the integration step chosen, the program calculates and prints out the displacement of centers of gravity of the cars, the wheel displacements, and the displacements of the track masses, as well as the first and second time derivatives of these motion parameters. The output also includes the wheel loads and beam deflections as functions of time. The program has a plotting and restart capability and several options with respect to the modeling of the vehicles. Author

N71-18105 California Univ., Los Angeles. Div. of Vocational Education.
AIR TRAFFIC CONTROL: A FEASIBILITY STUDY
David Allen, William K. Bowers, Richard L. Lano, and John M. Meyer 1970 177 p
Copyright. Avail: NTIS

A Task inventory of the air traffic controller occupation was conducted and development of performance objectives was analyzed. A preliminary listing of curriculum content is identified. A task inventory questionnaire was developed, data were collected and tabulated, and the data were analyzed with recommendations for curriculum content including the depth of required learning for each topic. Author

N71-18106# TRW Systems Group, Redondo Beach, Calif.
HIGH-SPEED GROUND TRANSPORTATION SYSTEMS ENGINEERING STUDY. SUPPORTING STUDIES FOR HSGT SYSTEM REPORTS Final Report
Jun. 1970 655 p refs
(Contract DOT-C-353-66(NEG))
(TRW-06818-6041-R0-00) Avail: NTIS HC $9.00/MF $0.95

Representative alternative high-speed ground transportation systems that can be engineered from current technology for service in the late 1970s or early 1980s are defined. The system definitions contain general design concepts and performance characteristics. Conceptual design studies are carried out only to the point of feasibility within current technology, computation of performance, and generation of cost estimation data. Tradeoffs between parameters and variations about the defined systems are demonstrated. Author

N71-18107# Voorhees (Alan M.) and Associates, Inc., McLean, Va.
SCREENING AND EVALUATION OF PUBLIC TRANSIT VEHICLE SYSTEMS
Feb. 1970 157 p refs Sponsored in part by DOT
(AMV-R-15-1073; TR-1) Avail: NTIS

Prospects for improved Twin Cities transit service through the use of new concept transit systems utilizing new technology are investigated. Initial screens were established for removing systems which lacked an appreciable degree of engineering and/or cost analysis and systems intended for serving travel function not significant to the Twin Cities' needs. The remaining systems were grouped for further evaluation into three categories: systems featuring contemporary technology, new technology systems utilizing large vehicles or nonautomated operation, and new technology systems utilizing small vehicles and automated operation. Some of the evaluation criteria related to the impact of transit on the overall community in terms of its physical, social, and economic factors. Other criteria were concerned with transit as a means of transportation, particularly as an alternative to complete reliance on the private automobile. Systems classified to be retained for further study are freeway and street buses, exclusive rights-of-way buses, rapid rail transit, and commuter railroad. Systems classified to be monitored for possible future use are gravity vacuum tube and small vehicle systems with automated operation. Author

N71-18112# Institute of Transport Aviation, Paris (France).
THE FREQUENCY OF SCHEDULED SERVICES: AN ANALYSIS OF AIR TRANSPORT SUPPLY
G. Desmas and R. Mathieu 1970 92 p
(Rept-1970/1-E) Avail: NTIS

A detailed analysis of air transport supply on scheduled services in one month of 1967 is presented for the Europe-Mediterranean region and Southeast Asia. Supply was measured by a set of four variables: the number of stages, flights, available seats, and available seat-km. The distribution of these variables was examined according to three parameters: frequency, the level of supply (in available seats), and stage length. A double classification was carried out and the stages sorted by frequency and distance, and then by frequency and supply level. The study was continued with mean values and, after determining the area in which the mean frequency/mean capacity combinations varied at the different supply levels, the relations existing between the mean frequency and mean supply level calculated for homogeneous groups of stages, and between the mean frequency and mean distance were investigated. An analysis was also made of aircraft type use and share in overall activity. It was found that the utilization of different aircraft was dispersed over a wide frequency range. The analysis was applied to Italy and Japan. Author

N71-18118 Michigan Univ., Ann Arbor. Bureau of Business Research.

ALTERNATIVE LOGISTICS SYSTEMS FOR EXPENSIVE PARTS: AN AIRLINE STUDY

William G. Browne 1969 242 p refs

Copyright. Avail: NTIS

The overhaul and inventory procedures of commercial airlines for major aircraft parts are analyzed, along with the policy alternatives for providing the services with increased efficiency. A computer simulation was developed to examine the impact on cost and service levels of different inventory and overhaul configurations for the GE-4 engine, which will be used to propel the SST. Experimentation with the different locations of overhaul facilities and inventory was conducted. The simulation included provisions for changes in ownership, engine status, number of overhaul facilities in the system, engine failure rates, overhaul times, and rates of fleet growth and system expansion. A survey of management attitudes toward increased consolidation indicates that overhaul facility location is the most critical factor inhibiting consolidation efforts. The major conclusions were: (1) considerable cost savings can be achieved through policy changes providing for intercompany consolidation of engine overhaul and storage facilities, and (2) the attainment of an overhaul and inventory consortium with more than three or four members is likely to be most difficult, considering present industry attitudes. Author

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